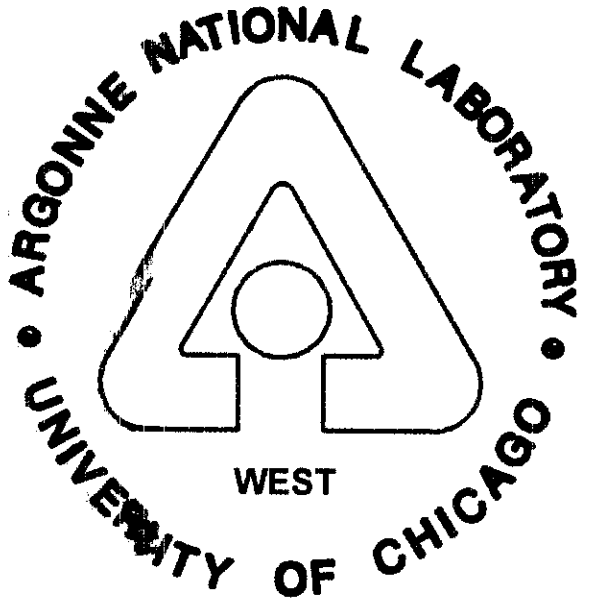
WAG 9

FINAL WORK PLAN

for OPERABLE UNIT 9-04: COMPREHENSIVE RI/FS

Volume I



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Restoration Section

Comprehensive RI/FS Final Work Plan for Waste Area Group 9

W7500-0000-ES-03

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RESTORATION SECTION
REVIEW AND APPROVAL SHEET

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REVIEW

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EXECUTIVE SUMMARY

In 1989, the Idaho National Engineering Laboratory (INEL) was added to the Environmental Protection Agency's (EPA's) national priorities list of superfund sites and a Federal Facility Agreement and Consent Order (FFA/CO) for the INEL was signed by the Department of Energy, Idaho Operations Office (DOE-ID); EPA; and the State of Idaho in December, 1991. The goal of this agreement is to ensure that:

- potential or actual INEL releases of hazardous substances to the environment are thoroughly investigated in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and
- appropriate response actions are taken as necessary to protect human health and the environment.

Of the ten INEL WAGs specified in the FFA/CO, ANL-W is identified as WAG 9. WAG 9 consists of four operable units (OUs) that include pits, tanks, rubble piles, ponds, cooling towers, wells, french drains, and perched water and spill areas. OU 9-04 is used for the comprehensive remedial investigation/feasibility study (RI/FS) for WAG 9. This investigation consolidates previous investigations conducted for this WAG and includes sites not yet assessed in a cumulative comprehensive manner in order to evaluate the overall risks posed by the WAG.

The initial Work Plan planning process was conducted at the WAG 9 Comprehensive RI/FS Scoping Meeting that was held on June 21 and 22, 1995. As discussed during the preliminary Scoping Meeting with EPA, IDHW and DOE, the major focus of the WAG 9 Comprehensive RI/FS Work Plan will be to complete a Screening and Data Gap Analysis (SDGA), Screening Level Ecological Risk Assessment (SLERA), ANL-W hydrogeologic study, and incorporation of facility screening process. The results of these major sections will indicate if data gaps exist. If no data gaps exist, then a Sampling and Analysis Plan will not be necessary. Each of these four major sections of the Work Plan are discussed below.

- The SDGA is the first step in performing the WAG 9 Cumulative Risk Assessment. The WAG 9 SDGA followed the same procedures used to conduct the SDGA for WAG 2.

The SDGA reviewed the operational history, old sample results and most recent supplemental sampling results for each site and identified Contaminants of Potential Concern (COPCs). The goal of the SDGA was to identify which sites need further screening for particular contaminants prior to completing the Cumulative Risk Assessment.

- The SLERA is similar to the SDGA with the exception that the SLERA identifies sites that have the potential to pose a risk to the ecological components at WAG 9, whereas the SDGA identified only the gaps for the Cumulative Risk Assessment. The WAG 9 SLERA followed the procedures as outlined in the Guidance Manual (LITCO, 1995a). The SLERA does not measure risk and is not a true risk assessment. Rather, the goal of the SLERA is to answer the question, "does a given site/contaminant pose a potential risk to ecological receptors, or does the site/contaminant present low likelihood for potential risk?" SLERAs are prerequisites to Ecological Risk Assessment (ERA) in assessing which sites and contaminants lack adequate data to perform an ERA.

- The *ANL-W Hydrogeologic study* reviewed the data in the INEL Groundwater Monitoring Plan and incorporate the most recent groundwater data at ANL-W to determine any data gaps. This study includes an overall assessment of the ANL-W groundwater monitoring program to determine if the program adequately monitors for potential releases from the ANL-W facility. ANL-W also evaluated if the existing groundwater monitoring wells provide adequate coverage for WAG 9 waste sites and type of contaminants.

- The last major section of the Work Plan is the facility screening for underground storage tanks, buildings, and radionuclide liquid storage tanks at the ANL-W facility. This screening process used at ANL-W was designed by DOE-ID, EPA, IDHW and INEL WAG managers. The screening process involved completing the standard tables with the information requested. The information requested is included in the accompanying flow charts and includes: operational history of a facility, types of wastes used and stored at the facility and future use of the facility to determine if the building poses a potential to release a CERCLA waste. If the facility or tank does not have the potential to be a release point it is eliminated from further evaluation. At ANL-W the information used

during the screening process was taken from an existing document at the ANL-W facility (*Surplus Facilities Inventory Assessment - Phase II*). This document was produced as part of a DOE EM-60 requirement to assess the decommissioning of the buildings at a facility.

ANL-W has submitted a Field Sampling Plan (FSP) for the samples that will be collected of the interbeds below the EBR-II Leach Pit as part of the Work Plan. This FSP references that the previously submitted and approved Quality Assurance Project Plan (QAPjP) will be used during the collection of the samples. The FSP combined with the QAPjP are referred to as a Sampling and Analysis Plan (SAP).

ACRONYMS

ANL-W	Argonne National Laboratory-West
ARAR	Applicable or relevant and appropriate requirement
BAF	Bio Accumulation Factor
BRA	Baseline Risk assessment
PUF	Plant Uptake Factor
COPC	Contaminant of potential concern
CSM	Conceptual site model
DOE-ARG	Department of Energy, Chicago Operations Office, Argonne Group
DOE-ARG-W	Department of Energy, Chicago Operations Office, Argonne Group-West
DOE-ID	Department of Energy, Idaho Operations Office
EBSL	Ecologically based screening levels
EPA	U. S. Environmental Protection Agency
ERA	Ecological Risk Assessment
FFA/CO	Federal facility agreement/consent order
FSP	Field Sampling Plan
HEAST	Health effects assessment summary table
IDHW	Idaho Department of Health and Welfare
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
QAPjP	Quality Assurance Project Plan
OU	Operable unit
RfD	Reference dose
RI/BRA	Remedial investigation/baseline risk assessment
RI/FS	Remedial investigation/feasibility study
SAP	Sampling and Analysis Plan
SDGA	Screening and data gap analysis
SF	Slope factor
SLERA	Screening Level Ecological Risk Assessment
SLQ	Screening Level Quotients
SOW	Scope of work
TRV	Toxicity Reference Value
UCL	95% Upper Confidence Level of the mean
VOC	Volatile organic compound
WAG	Waste area group

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1 INTRODUCTION

In 1989, the Idaho National Engineering Laboratory (INEL) was added to the Environmental Protection Agency's (EPA's) National Priorities List of Superfund sites. A Federal Facility Agreement and Consent Order (FFA/CO) for the INEL was signed by the Department of Energy, Idaho Operations Office (DOE-ID), EPA, and the State of Idaho in December 1991. The goal of this agreement is to ensure that potential or actual INEL releases of hazardous substance to the environment are thoroughly investigated in accordance with the National Contingency Plan (NCP) and that appropriate response actions are taken as necessary to protect human health and the environment.

1.1 INEL and WAG-9 Background

Argonne National Laboratory-West (ANL-W) is part of the INEL, a federally owned reservation that is dedicated mainly to energy research and development and waste management. The INEL has been divided into ten Waste Area Groups (WAGs) as identified in the FFA/CO. Of the ten WAGs on the INEL, ANL-W is identified as WAG 9.

The INEL was established in 1949 on the Snake River plain of southeast Idaho. It covers an area of 893 square miles (2313 km^2), about three-quarters the area of the state of Rhode Island. The area now administered by ANL-W is slightly over one square mile (2.5 km^2). The ANL-W site is located approximately 30 miles west of the city of Idaho Falls, just north of U.S. Highway 20. Figure 1-1 shows the location of ANL-W with respect to the INEL and the State of Idaho.

This Remedial Investigation and Feasibility Study Work Plan addresses the contamination from 37 sites identified in the FFA/CO for WAG 9. In the FFA/CO the sites are listed as follows: 18 No Action sites, 10 OU 9-01 Track 1 sites, one OU 9-02 Track 2 site, three OU 9-03 Track 2 sites and five OU 9-04 RI/FS sites. To date all 10 Track 1 sites have been signed No Further Action determination in Decision Documentation Packages with ANL-04 requiring modeling in the RI/FS . Both Track 2 OU's (9-02 and 9-03) have been signed No Further Action by the RPMs in Summary Reports with additional modeling in the RI/FS for contaminants in the vadose zone for ANL-08. And in 1994, samples were collected of the OU 9-04 sites and the results were submitted to EPA and IDHW for review and comment in the form of Preliminary Scoping Packages.

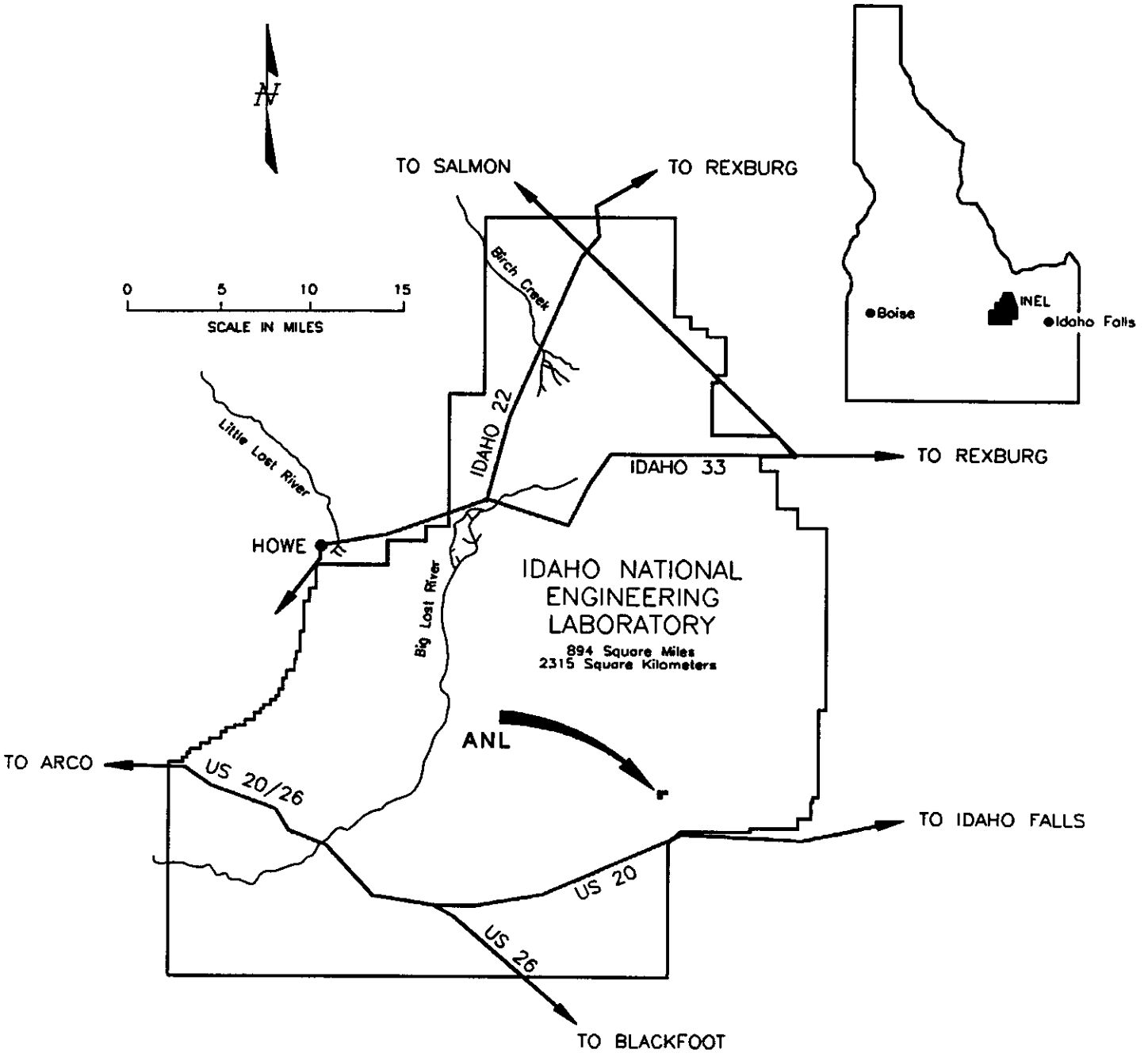

Figure 1-1 Location of ANL-W with respect to the INEL and the State of Idaho.

On February 3 and 4, 1994, a WAG 9 scoping meeting was held at the ANL-W facility to discuss the scoping documents (OU 9-04 Preliminary Scoping Packages) that were submitted for review and to discuss the possibilities of accelerating the Comprehensive RI/FS. Those who attended this meeting were WAG 9 managers from EPA, IDHW, DOE-ARG, DOE-ARG-W and ANL-W Environmental Remediation personnel. At this meeting all of the 19 identified FFA/CO sites were discussed and WAG 9 managers concerns/resolutions as well as recommendations for future sampling, and methods for accelerating the FFA/CO process were discussed. ANL-W personnel have since conducted the pre-RI sample collection activities in OU 9-04 to fill the identified data gaps in order to complete the Comprehensive RI/FS in an accelerated manner.

1.2 Scope of Work Plan

This Work Plan summarizes the data gaps of the SDGA, hydrogeologic investigation, SLERA, and facility screening of potential release sites to determine which sites will require additional characterization in order to meet the objectives of the WAG 9 Comprehensive RI/FS. The RI with BRA will determine if the cumulative effects of all WAG 9 OUs present a significant risk to human health or the environment. As part of the determination of the overall cumulative effect to humans and the environment, the risks associated with the potential releases from WAG 9 OUs to the groundwater will be evaluated. The RI with BRA will evaluate the individual sites of OU 9-04 to determine if they present a significant risk to human health and if any remedial actions are necessary for these sites. The objectives of the completed RI/FS include the following:

- Perform a cumulative risk assessment of WAG 9 including the identification of potential sources of contamination through the soil, air, surface water, and groundwater.
- Determine if co-located, or nearby sites have the potential for significant cumulative risks via inhalation of fugitive dust, ingestion of groundwater and the external exposure pathway.
- Conduct a SDGA for all 19 WAG 9 sites. This will be conducted by revisiting the Track 1s and Track 2s to determine if there are data gaps. This will identify any sites which may need further sampling in order to fully quantify the nature and extent of the contaminants present.
- Perform a hydrogeologic study to evaluate past and potential future releases to the groundwater. This study will also determine if the underlying aquifer is or potentially may be unacceptably contaminated and recommend alternatives for it's cleanup. This study will provide necessary information on the groundwater pathway for the cumulative risk assessment.

- Perform a WAG 9 Screening Level Ecological Risk Assessment (SLERA). This SLERA will identify which data gaps need to be filled prior to conduction of the WAG 9 wide ecological risk assessment. The WAG wide Ecological Risk Assessment will be completed and submitted with the human health Baseline Risk Assessment.
- Identify, screen, evaluate and develop in detail, the remedial action alternatives.
- All buildings and structures will be screened for their potential to release hazardous and/or radioactive constituents.
- Complete assessments on certain sites which have been deferred to the RI and/or FS.

1.3 Physical and Hydrogeologic Setting

Characteristics of the uppermost water-bearing units beneath ANL-W, plus regional and local physiographic, meteorologic, ecologic, geologic and hydrologic settings of the ANL-W facilities are summarized in the following sections. This information has been assembled from several existing documents (Robertson 1974, Pittman, et. al., 1988) and the INEL Groundwater Monitoring Plan. Figures 1-4 through 1-6 are included in the back of Section 1 and show a shaded relief map from satellite and two aerial photos of the ANL-W site.

1.3.1 Physiographic and Geomorphic Setting

The ANL-W facility is found in the southeastern portion of the INEL and is responsible for a roughly rectangular shaped administrative area encompassing approximately 890 acres. ANL-W facilities are within a local topographically closed-basin. The surface of the facility slopes gradually from south to north, at approximately 30 ft per mile. Maximum topographic relief within the ANL-W administrative boundary is about 50 ft, ranging from 5110 ft above mean sea level on the north boundary to 5160 ft on a basalt ridge to the southeast.

The Twin Buttes are the most prominent topographic features within the INEL and are found to the southwest of ANL-W. East and Middle Twin Buttes rise 1100 and 800 feet respectively above the plain. Big Southern Butte, a composite acidic volcanic dome several miles south of the INEL, is the most prominent single feature on the entire plain, rising approximately 2500 feet above the level of the plain.

1.3.2 Meteorology

The U. S. Weather Bureau established a monitoring station at the Central Facilities Area (CFA) in 1949. Historical climatological observations from this area have been compiled by Clawson (1989). A 250-foot tower is also located just outside the east security fence of the

ANL-W area, however, this tower has not been in continuous operation for as long as the CFA station.

1.3.2.1 Air Temperature

Data has been collected from both two meters and ten meters above the ground surface at ANL-W. The two-meter data set is limited in time from August 1993 to the present. The record presented is considered typical of temperature conditions in the vicinity of the ANL-W facility. Although there is a much longer record available from the CFA station, the distance of ANL-W from that station precludes its use. Therefore, this data is presented here in that it more accurately portrays surface conditions at ANL-W. The maximum average monthly temperature during the time of record was in July of 84.8°F. The minimum average monthly temperature of 7.9°F was recorded in December. Table 1-1 shows monthly mean, maximum, and minimum for the time of record at ANL-W.

Table 1-1 Monthly Temperatures (8/93-7/95)

Month[a]	Mean[b]	Maximum[b]	Minimum[b]
January	22.5	31.6	12.9
February	25.1	36.7	13.8
March	35.1	48.4	22.1
April	42.9	56.2	27.8
May	52.1	65.2	37.1
June	59.3	73.7	41.0
July	67.2	84.8	46.5
August	65.3	83.3	44.7
September	57.0	75.7	36.2
October	41.8	56.6	27.5
November	22.7	35.4	8.9
December	19.8	29.0	7.9

[a] Time period August 1993 to July 1995.
[b] All values in degrees Farenhiet.

1.3.2.2 Precipitation

Precipitation and humidity are not measured at the ANL-W tower. However, the National Oceanic and Atmospheric Administration (NOAA) did an evaluation and is of the opinion that the use of CFA data for these parameters is reasonable (Hukari, 1995). Precipitation was measured as rainfall and snowfall for the period January 1950 to December 1988. During this period most of the precipitation was received in May and June and averaged 1.2 inches. The annual total average was 8.71 inches. As expected, most snowfall occurred during December and January. The monthly average snowfall event for December and January was 6.4 inches and 6.1 inches, respectively. Wet bulb temperature humidity measurements from CFA run from 1956 to 1961. The highest average occurred in the winter at 55%, a low average of 18% was recorded in the summer.

1.3.2.3 Evaporation and Infiltration

Although NOAA does not measure pan evaporation at the INEL, adjusted Class A values have been made through regression analysis of other southeast Idaho sites. Data from 1950-51, 1958-59, 1963-64, and 1969-70 yielded an adjusted range of 40 to 46 inches per year. Other estimates for the INEL (Hull, 1989) have values of 36 inches per year from saturated ground, 32 to 36 inches per year from shallow lakes, and six to nine inches per year from native vegetation.

Evaporation rates calculated from the drop in level of the Industrial Waste Pond during 1995 yield values between 0.43 in/day and 0.10 in/day for summer and winter, respectively. Infiltration is calculated by using the hydrologic equation and solving for the infiltration term. This yields values for the IWP of between 0.36 in/day and 0.07 in/day for summer and winter, respectively.

1.3.2.4 Wind

Wind measurements at ANL-W are made at ten meters and 250 feet above the ground surface. From this data ANL-W is clearly subject to the same southwest and northeast winds as the rest of the INEL. Winds tend to be diurnal with up slope winds (those out of the southeast) occurring during the day and down slope winds (those out of the northeast) occurring at night. During the five-year time of record at ANL-W from 1990 to 1994 winds blew from the southeast 14% of the time, from the south-southeast 11% of the time, and from the northeast 10% of the time. Winds were calm during only 2.49% of the time on record. An annual total wind rose for the period 1990 to 1994 is shown in Figure 1-2.

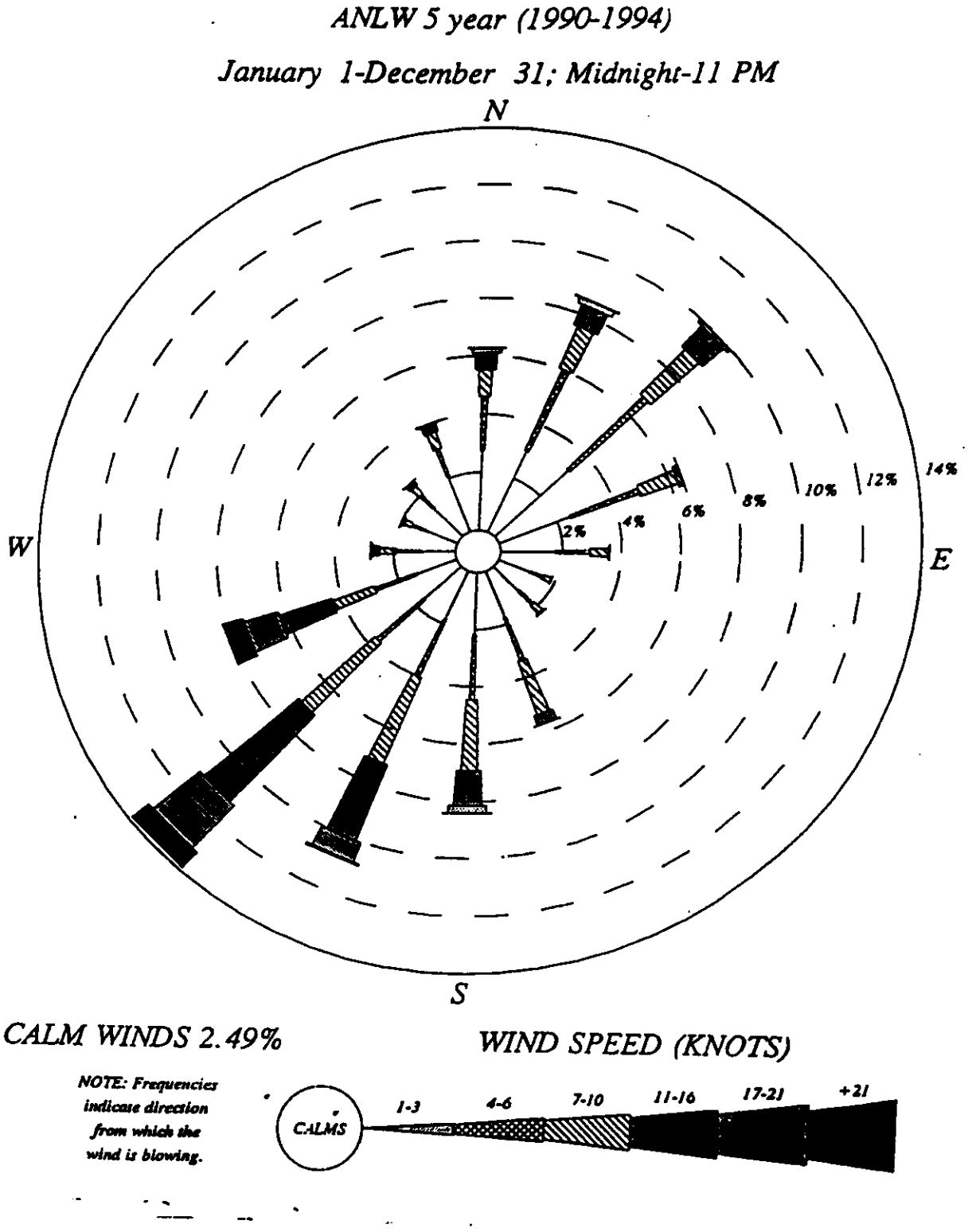

Figure 1-2 ANL-W 5 Year Wind Rose 1990-1994

1.3.2.5 Special Phenomena

A thunderstorm is defined by the National Weather Service as a day on which thunder is heard at a given station. According to this definition, lightning, rain and/or hail are not required during a thunderstorm. Following this strict definition ANL-W may experience two to three thunderstorm days from June to August. Thunderstorms have been observed during each month of the year, but only rarely from November to February. Thunderstorms on the INEL tend to be less severe than in the surrounding mountains because of the high cloud base. In many instances precipitation from a storm will evaporate before reaching the ground. Individual storms may, however, occasionally exceed long-term average rain amounts for a storm.

Local thunderstorms may also be accompanied by micro bursts. These micro bursts can produce dust storms and occasional wind damage. Thunderstorms may also be accompanied by both cloud-to-ground and cloud-to-cloud lightning.

Because there are no permanent, natural, surface water features near ANL-W flooding is not a major concern. The facility has been inundated in the past by rapid snow melt events. To control this, a diversion dam was constructed south of the facility. This dam has a gate that, when closed, diverts water into the adjacent drainage and directly into the IWP.

1.3.3 Geology

A detailed geologic history of the Eastern Snake River Plain is not necessary to fulfill the purposes of this work plan. This subsection describes the local geological characteristics at ANL-W. Where applicable, pertinent geological information, including geomorphology, stratigraphy, lithology and bedrock structure, is also described.

1.3.3.1 Surface Geology

The ANL-W facilities are found within a topographically closed basin. Low ridges of basalt found east of the area rise as high as 100 feet above the level of the plain. Surficial sediments cover most of the underlying basalt, except where pressure ridges form basalt outcrops. Thickness of these surficial sediments ranges from zero to 20 feet (Northern Engineering and Testing, Inc., 1988).

Test borings at ANL-W have revealed two distinct layers in the surface sediments. The uppermost layer, from zero to several feet below land surface (BLS), consists of a light brown

silty loam. The upper one to two feet of this silty loam layer contains plant roots. This silty loam layer may also contain basalt fragments in areas where it directly overlies basalt.

The lower layer is a sandy-silt (loess) that extends to the underlying basalt. The loess of this layer was probably transported by wind from other parts of the plain. The windblown loess is calcareous and light buff to brown in color. Small discrete lenses of well-sorted sands that occur within the loess are probably the result of reworking by surface runoff into local depressions. The lower portion of this loess layer often contains basalt fragments of gravel to boulder size. The surface of the underlying basalt, whether it is in contact with the upper or lower layer is highly irregular, weathered and often very fractured.

1.3.3.2 Subsurface Geology

The subsurface lithology presented in this section is based on information gathered from past and recent borings around the ANL-W facility. Information gathered from recent borings (i.e., those drilled after 1992) have led to a better understanding of the subsurface geology around ANL-W. The deep geology around ANL-W is dominated by basaltic lava flows. Minor discontinuous sedimentary interbeds occur at various depths, overlying the tops of basalt flows.

The subsurface geology at ANL-W is similar to that of the rest of the INEL. The most striking difference is the lack of continuous sedimentary interbeds beneath the facility. Those sedimentary interbeds intercepted during drilling appear to be discontinuous stringers, deposited in low areas on basalt surfaces. These interbeds are generally composed of calcareous silt, sand or cinders. Rubble layers between individual basalt flows are composed of sand and gravel to boulder sized material. The interbeds range in thickness from less than one inch to 15 ft. Drilling near areas of contaminant concern (industrial waste pond and cooling tower blowdown ditches) targeted a discontinuous, but locally extensive, interbed found approximately 40 to 50 ft BLS, near the waste pond area. This interbed is not continuous across the ANL-W area and does not appear west of the industrial waste pond. More aerially extensive interbeds have been identified above the regional water table, at approximately 400 ft, 550 ft, and 600 ft BLS (Northern Engineering and Testing, Inc., 1988). The nature of these sedimentary interbeds and rubble zones does not appear to cause perching, but may retard the downward movement of water and produce preferred flow paths.

The thickness and texture of individual basalt (lava) flows is quite variable. Individual basalt flows range in thickness from 10 to 100 ft. The upper surfaces of the basalt flows are often irregular and contain many fractures and joints that may be filled with sediment. The existence of rubble zones at variable depth and extent are shown from caliper logs of hole diameter that reveal

zones of blocky or loose basalt. Exposed fractures commonly have silt and clay infilling material. The outer portions of a flow (both top and bottom) tend to be highly vesicular. The middle portions of the flow typically have few vesicles and are dominated by vertical fractures formed during cooling.

The variability of basalt thickness and fracturing also plays an important role in well response to changes in the SRPA. This effect is most notable in well responses to barometric pressure changes. Most of the wells at ANL-W act as water table wells with a rapid responses to barometric fluctuations. However, well ANL-MON-A-11 is very slow to respond to barometric changes, often taking many hours to reequilibriate to barometric shifts. Review of the driller's log for this well shows that a thick, apparently massive, basalt rests just above the water table at this location. This thick flow acts as a confining layer and restricts free air exchange near the well bore. Discussions with the INEL field office of USGS suggest this is common on the INEL and that the local area of such affects tends to be on the order of hundreds of feet. Neither the USGS nor ANL-W believes this effect influences the wells' ability to intercept contaminants from the leach pit (ANL-08). Furthermore, placement of the well away from the immediate down gradient edge of the source area allows for any lateral spreading of contaminants that may occur above this dense basalt before entry into the aquifer.

The sequence of interbedded basalt and sediments, discussed above, continues to well below the regional water table. The regional water table is typically encountered at an elevation of about 4483 feet above mean sea level (AMSL) near the ANL-W facility. A deep corehole was drilled in 1994 in an attempt to locate the effective base of the aquifer. This base is a layer below which the hydraulic conductivities drop by orders of magnitude. The contact of the effective base is characterized by a large sedimentary interbed (up to 100 feet thick) and a marked change in the alteration of the basalts. This contact was encountered at a depth of 1795 feet BLS in the deep corehole at ANL-W. The sedimentary layer was approximately 15 feet thick.

1.3.4 Soils

Soil samples have been collected in and around the IWP to support specific investigations.

1.3.4.1 Soil Survey

A formal Soil Conservation Service (SCS) soil survey map is not available for the ANL-W site. A general soil map (Figure 1-2) shows the soil units representative of the predominant soil series as mapped at the INEL. The soils around the ANL-W facility have been

mapped as Aecet-Bereniceton-Bondforms. A description of the soil mapping is included in Appendix C.

1.3.4.2 Soil Physical Properties

Physical properties for soils at ANL-W are limited to general information such as cation exchange capacity (CEC), pH, grain size and acid/base potential. Soils collected for a 1989 background study from two separate areas analyzed for pH, specific conductance, cation exchange capacity and acid/base potential form the basis for this data (Chen-Northern, Inc., 1989a). Samples were collected in 1.5 foot increments to 7.5 feet or the top of basalt, whichever was encountered first. Sample locations are shown in Appendix B. Sample STF1-2 is from an undisturbed site east of the ANL-W facility. NWC1-2 is located east of the industrial waste pond. Table 1-2 shows the results of those analyses for the upper three feet of soil.

Table 1-2 Background Soil Sample Analysis

Sample No.	Depth (ft)	pH (s.u.)	Sp. Cond. (μmhos/cm)	CEC (meq/100g)	Acid/Base Potential (tons $CaCO_3$/ 1000tons)
STF1-2	0 - 1.5	7.4	4.68	20	97
	1.5 - 3.0	7.5	10.9	16	164
NWC1-2	0 - 1.5	7.4	0.66	36	47
	1.5 - 3.0	7.6	0.68	30	92

(From Chen-Northern 1989a)

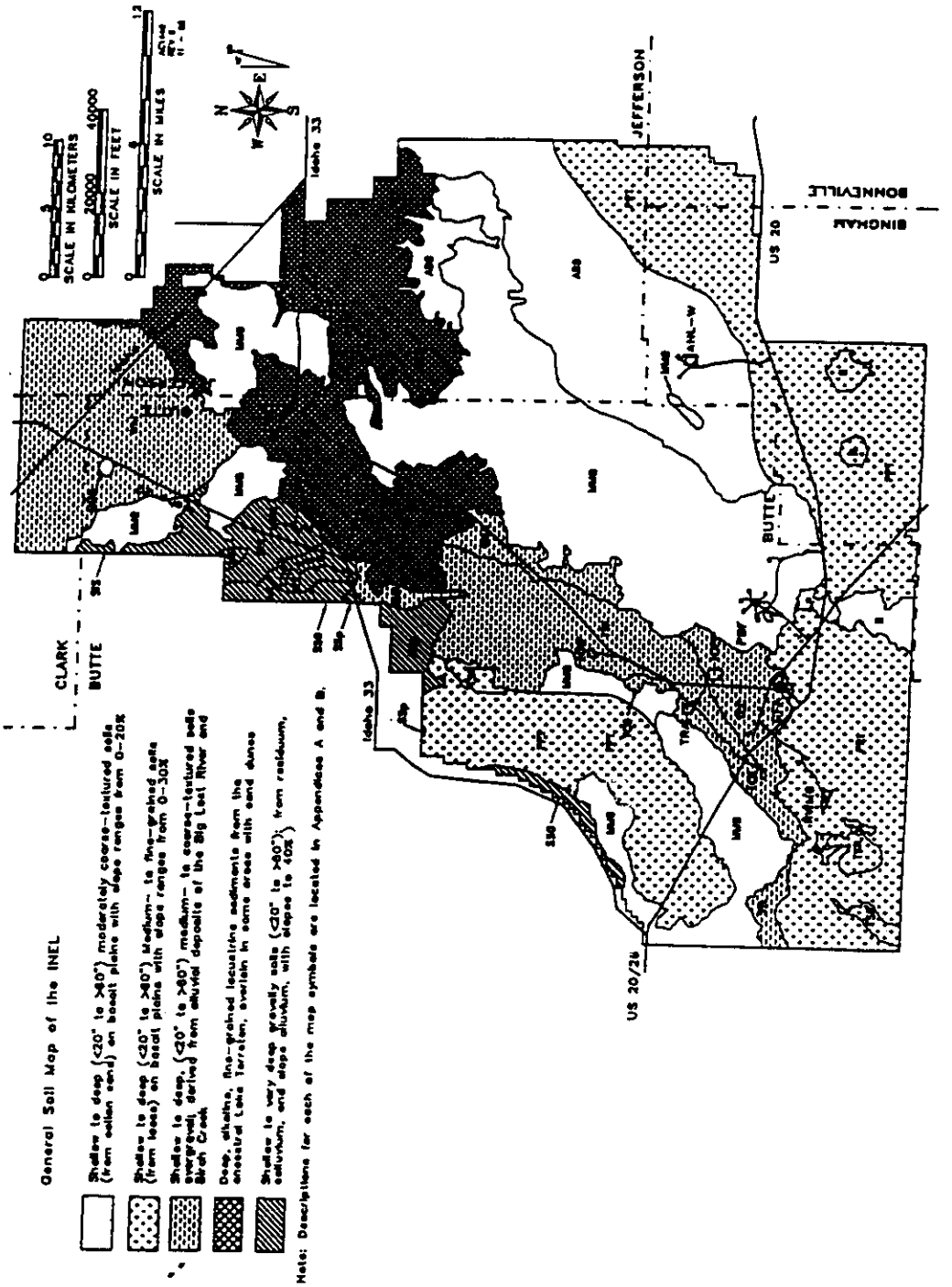

Figure 1-3 General Soil Map of the INEL

1.3.4.3 Soil Chemical Properties

As mentioned previously, soil sampling at ANL-W has been conducted to support specific investigations. Samples collected in the 1989 background study (Chen-Northern, 1989a) were also composited by depth and analyzed for 40 CFR 261, Appendix VIII inorganics. Table 1-3 shows those results for the 0 - 1.5 and 1.5 - 3.0 foot depths. These values are shown compared to the INEL averages as given in Rood (1995). The INEL values are used for further evaluation in this work plan because the Chen-Northern data is not qualified.

1.3.5 Hydrogeology

This hydrogeologic summary is a compilation of the data that has been collected up to 1993. A detailed hydrogeologic section is found in Section 3 of this Work Plan. All of the ANL-W data to date, including the new gradient maps, sample results, flow direction over the years and pump test results, is in Section 3 or Appendix D of this Work Plan. This section presents a synopsis of the regional and local hydrogeologic characteristics. A more complete description of the local hydrogeology is located in Section 3 of this Work Plan.

1.3.5.1 Vadose Zone

The vadose zone at the INEL varies from 200 feet in the north to over 900 feet in the southeast. Near the ANL-W facility it is approximately 640 feet thick. However, physical and chemical properties of vadose zone materials have only been determined for the upper 100 feet. The vadose zone at the INEL and ANL-W is composed of layered basalt flows often with sedimentary layers between flows. Recent explorations at ANL-W have shown a distinct lack of sedimentary layers in the vadose zone. Moisture within the vadose zone will move vertically until encountering a low permeability layer. Here the moisture may move laterally or be retarded (forming saturated zones) until adequate head is obtained to move moisture through the low permeability zone. Around the ANL-W facility, moisture movement in the vadose zone is almost exclusively vertical to the water table. The little, if any, lateral movement that does occur is more a factor of travel along preferential flow paths (i.e., fractures) than spreading out on top of sedimentary interbeds.

Table 1-3 Results of 1989 Background Soil Sampling

Parameter	BG-S-1 (0' - 1.5')	BG-S-2 (1.5' - 3.0')	INEL 95-95.[A, B]
Aluminum[C]	13,300	13,000	24,000
Antimony	< 1.1	< 1.1	7.4
Arsenic	13	16	7.4
Barium	191	237	440
Beryllium	3.7	3.6	3.0
Cadmium	2.0	2.7	3.7
Cerium	15,606	77,066	ND
Chromium	20	22	50
Copper	22	29	32
Iron	15,900	14,300	35,000
Lead	14	14	23
Mercury	< 0.1	< 0.1	0.074
Nickel	26	29	55
Potassium	4,630	3,630	6,300
Selenium	< 0.5	< 0.6	0.34
Silver	< 0.5	< 0.6	6.0
Sodium	577	1,700	520
Thallium	< 0.6	< 0.7	0.68
Vanadium	28	38	70
Zinc	67	60	220
Cyanide	< 1.3	< 1.4	ND
Strontium	49	76	ND
Penols	0.4	< 0.1	ND
Sulfide	< 11.0	< 11.0	ND

[A] From Rood, et. al., 1995. [B] INEL Values will be used for contaminant screening.
[C] All values are in mg/kg ND No Data

1.3.5.2 Surface Water

Recharge to the Snake River Plain Aquifer (SRPA) in the vicinity of ANL-W occurs as snow melt or rain. During rapid snow melt in the spring, moderate recharge to the aquifer can occur. However, high evapotranspiration rates during the summer and early fall prevents significant infiltration from rainfall during these periods. Because of the distance from the surrounding mountains and permanent surface water features (i.e., the Big Lost River) the SRPA beneath ANL-W is unaffected by underflow or recharge from these sources.

No permanent, natural, surface water features exist near the ANL-W site. The existing surface water features (e.g., drainage ditches and discharge ponds) were constructed for ANL-W operations for the collection of intermittent surface runoff. A natural drainage channel has been altered to discharge to the IWP via the Interceptor Canal. Under the unusual conditions when the air temperature has been warm enough to cause snow-melt, but the ground has remained frozen, precluding infiltration, surface runoff along this channel has discharged to the IWP. This condition most recently occurred during the spring of 1995. During this time flow was visible from the surrounding basin into the IWP for approximately four days. However, at no time did any water discharge from the pond to the downstream channel. Before 1995, the most recent occurrence of this situation was in 1976.

1.3.5.3 Groundwater

Groundwater can be divided into two different types, perched and aquifer. Each type is discussed separately below.

1.3.5.3.1 Perched Water

Perched water is defined as a discontinuous saturated lens with unsaturated conditions existing both above and below the lens (Freeze and Cherry, 1979). Classical conceptualization of a perched water body implies a large, continuous zone of saturation capable of producing some amount of water. This view fits well for much of the INEL where low permeability sediments beneath waste ponds have developed such bodies. However, in the subsurface basalts at ANL-W, the "perched water" appears as small, localized zones of saturated conditions above some interbeds and within basalt fractures, that are incapable of producing any significant amount of water.

1.3.5.3.2 Snake River Plain Aquifer

Estimates show nearly $2x10^9$ acre-feet of water exist in the SRPA with water usage within the boundaries of the INEL being approximately $5.6x10^3$ acre-feet per year. From 1979 to 1994, ANL-W withdrew an average of 138 million gallons of water per year from the SRPA. Principal uses of the water are for plant cooling water operations, boiler water and potable water.

Regional flow in the SRPA is from northeast to southwest. The depth to the SRPA near the ANL-W facility is approximately 640 feet BLS, based on 1995 water level measurements. Transmissivities of the SRPA range from 29,000 to 556,000 feet squared per day, based on aquifer test data from two production wells at ANL-W (Martin et.al., 1993).

1.4 SDGA Overview

The SDGA will evaluate if any of the WAG 9 sites have data gaps that will need to be assessed. A potential data gap does not necessarily mean additional sampling. But, it may call for additional research of existing data or validation of data. The SDGA is found in Section 2 of this Work Plan.

1.5 SLERA Overview

This screening level ecological risk assessment (SLERA) for Waste Area Group 9 (WAG 9) at the Idaho National Engineering Laboratory (INEL), was performed using the methodology developed in the *Guidance Manual for Conducting Screening Level Ecological Risk Assessments at the INEL* (VanHorn et al. 1995), subsequently referred to as the Guidance Manual. Those contaminants present at WAG 9 that have the potential to cause undesirable ecological effects were identified and those sites identified in the Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID, 1991a) were evaluated. Any site for which there was inadequate sampling information to determine potential ecological effects was acknowledged. This SLERA is intended to support more detailed screenings and/or follow up ecological risk assessments (ERAs) or other screening (if required) allowing subsequent efforts to be focused on the more important contaminants and sites. Because the WAG 9 SLERA is a stand alone document, excerpts (objectives, scope, summary and transformation to ERA) are in the text of this Work Plan. The whole WAG 9 SLERA document is located in Appendix C of this Work Plan.

1.5.1 SLERA Objectives

The objectives of the SLERA for WAG 9 were to:

- Identify those contaminants that may contribute to a potential ecological risk
- Identify those sites that contain levels of contamination contributing to this possible risk
- Indicate those sites for which additional data and/or monitoring is needed for performance of a more detailed ERA, if required, or finalization of the SLERA, if found to be a potential contributor to ecological risk through this initial screening process.

1.6 Facility Screening of Possible Release Sites Overview

In addition to those sites identified in the FFA/CO Action Plan, ANL-W will also include the evaluation of potential release site and inactive or surplus facilities into the Comprehensive RI/FS and add any new sites per the new site identification form. To complete this activity ANL-W has located a *Surplus Facilities Inventory Assessment - Phase II* (ANL-W 1994) document that lists all the buildings and tanks at ANL-W, current mission, future mission, operation history and types of hazardous wastes used in the buildings. This document provided ANL-W with the background information used to complete the screening tables. Those facilities and or tanks that are not screened will be added to the WAG 9 Comprehensive RI/FS. ANL-W will add a discussion of qualitative risks posed by these facilities in the Risk Assessment uncertainty section.

1.7 Report Organization

This report consists of this section, which provides a brief description of the INEL and WAG-9 site background. The remainder of the Final Work Plan Sections along with their purpose are shown in Table 1-4.

Table 1-4 Draft Work Plan Report Organization

Section	Purpose
Section 1, Background	Background information of previous activities in WAG 9.
Section 2, SDGA	Screening and Data Gap Analysis of all 37 identified FFA/CO sites.
Section 3, Hydrogeologic	Summary of known WAG 9 hydrogeologic information.
Section 4, SLERA	Screening Level Ecological Risk Assessment using previous sampling data results.
Section 5, Facility Screening	Re-evaluation of all facilities (buildings and tanks) on the ANL-W site. Used to screen for potential release sites.
Section 6, Risk Assessment Methodology	How ANL-W will perform the Human Health and Ecologic Baseline Risk Assessment and cumulative risk assessments.
Section 7, Sampling and Analysis Plan	Summary of the proposed number, type, and location of samples to be collected for the WAG 9 as part of the Remedial Investigation.
Section 8, Quality Assurance Project Plan	Document to help ensure that the proposed samples will be collected in the correct frequency and analyzed using the correct procedures.
Section 9, References	References used in preparing the Work Plan.

Idaho National Engineering Laboratory
Shaded Relief Map

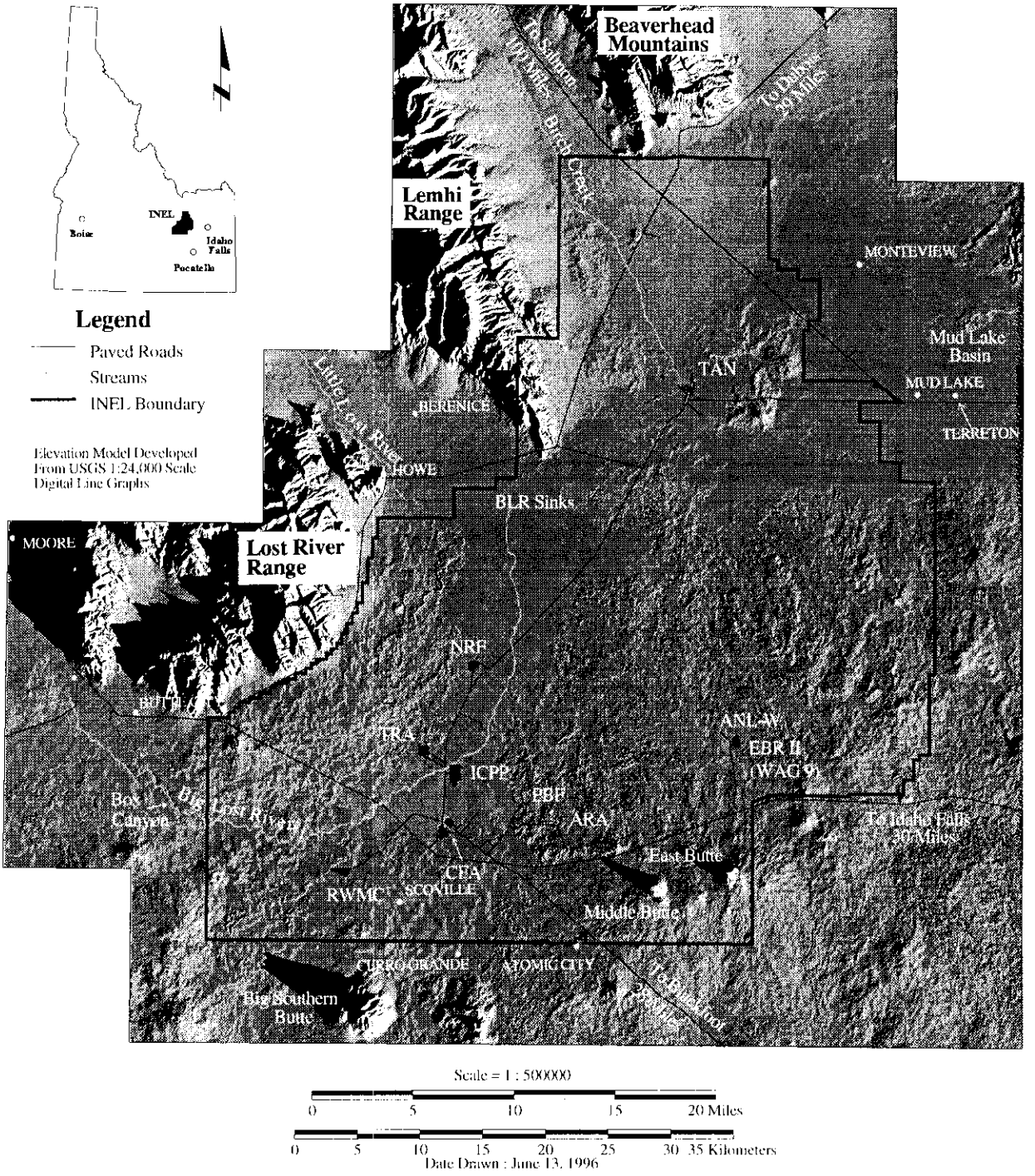

Figure 1-4. Location of WAG 9 and INEL

FIGURE 1-5 Aerial Photo of the ANL-W Site

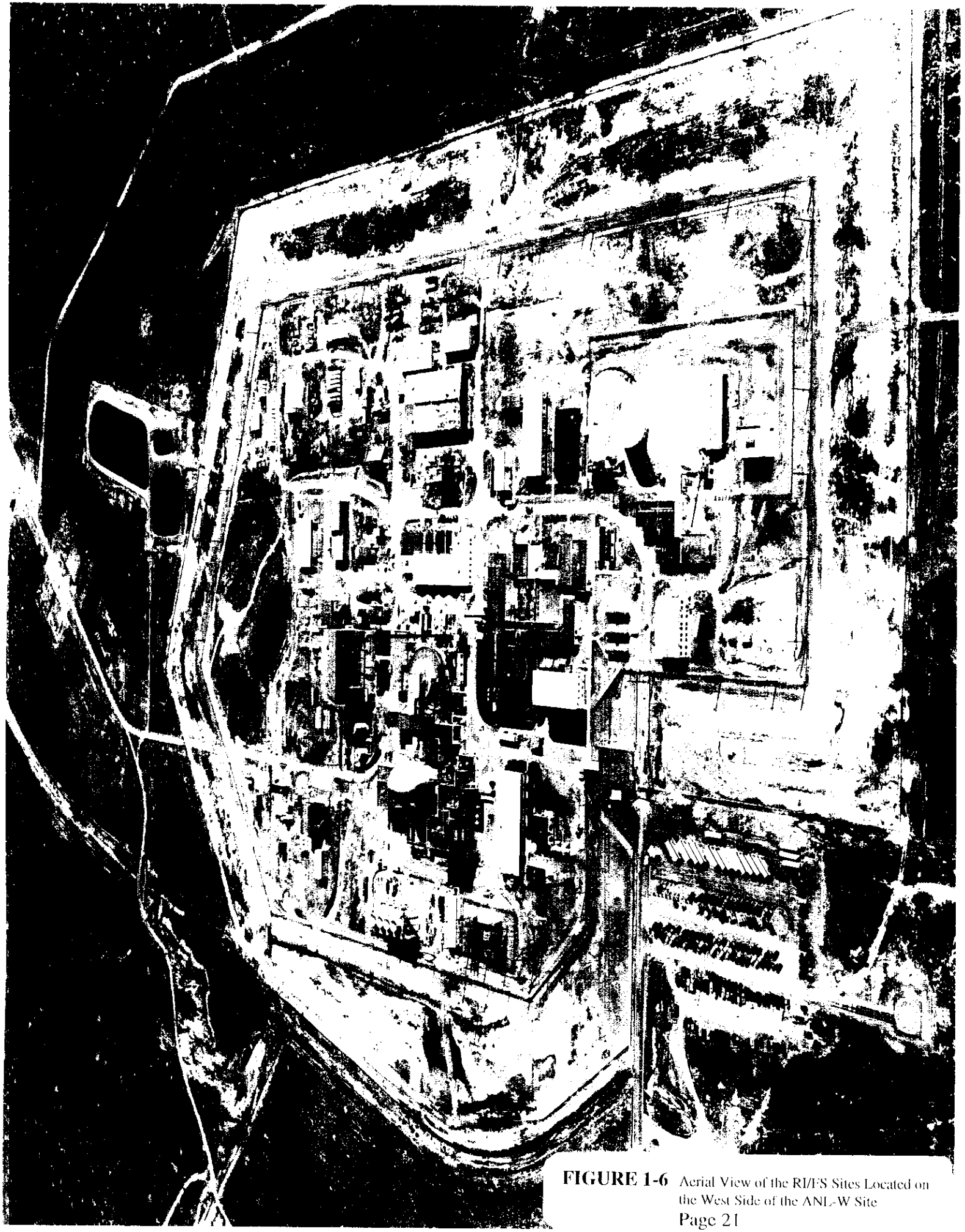

FIGURE 1-6 Aerial View of the RI/FS Sites Located on the West Side of the ANL-W Site

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2 IDENTIFICATION OF SCREENED SITES AND CONTAMINANTS

The identification of data gaps is the most important part of the scoping process. These data gaps were identified by evaluating the existing data and determining what additional data were necessary for the following purposes: (a) to complete characterization of the WAG 9; (b) to develop a better conceptual understanding of WAG 9 in its entirety and its cumulative and comprehensive risks; (c) to better define applicable or relevant and appropriate requirements (ARARs); and (d) to identify and screen remedial alternatives. A data gap does not necessarily require additional sampling of a particular site. It may involve collecting additional historical or process knowledge or it may include extrapolating analytical data from a similar site to a site with an analytical data need.

Data gaps were identified after review of Track 1, Track 2 and other investigation documents for each operable unit. A data gap for the WAG 9 comprehensive RI/FS was identified if the available documentation indicated that: (a) specific media were not evaluated in the Track 1 or Track 2 investigations; (b) insufficient data existed to conduct a risk evaluation; or (c) the risk was previously unevaluated.

This section of the SDGA presents the site screening methodology and results, a summary of all release sites within WAG 9, the contaminant screening methodology and results and a summary of potential data gaps. Sites within WAG 9 were screened using the site and contaminant screening methodologies presented in *Guidance Protocol of Cumulative Risk Assessments at the INEL* (INEL, 1995). Figure 2-1 illustrates the site and contaminant screening.

2.1 Site Screening Methodology

In the site screening the two primary criteria for retaining a site are: (a) if a COPC exists for a site or (b) if a data gap for a site exists. The steps to complete the site screening are presented below:

1. Compile information for WAG 9 sites.

2. Identify newly identified and unevaluated sites.

3. Eliminate "No Action" sites and sites for which a source does not exist.

4. Eliminate sites for which no contamination was detected or the risk was determined to be less than 1E-06 and the hazard quotient less than 1 as a result of previous risk evaluation activities (e.g. Track 1, Track 2, or other investigations), if less than 10 sites are eliminated by this step.

5. Retain sites containing known contamination for further evaluation against the contaminant screening criteria.

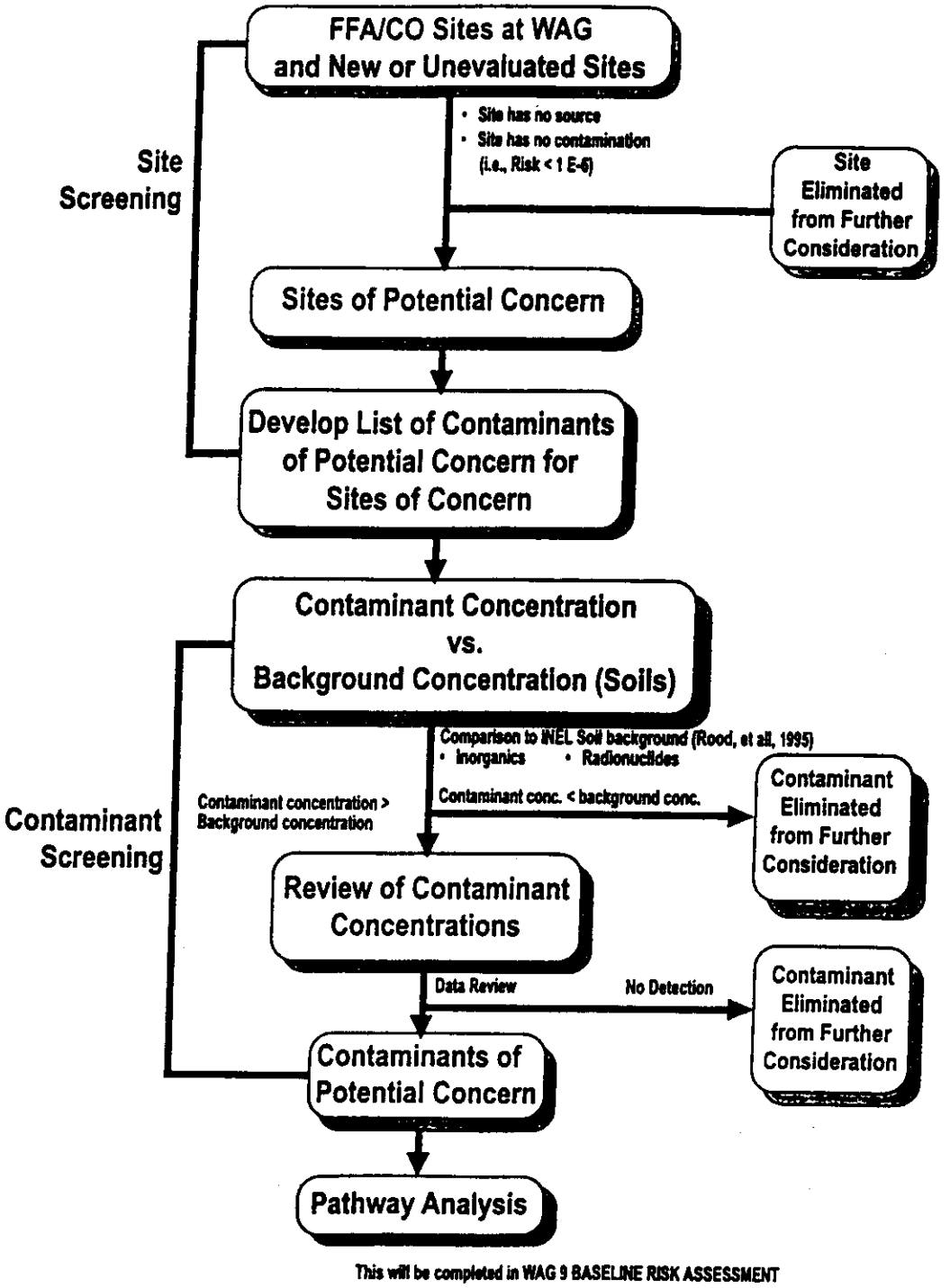

Figure 2-1 Site Contamination Screening Methodology

In step 4, if greater than 10 sites are eliminated using this step, then the risk screening level becomes 1E-07 and the screening hazard quotient becomes 0.1.

2.2 Step 1—Compile Information for WAG 9 Sites

In the Federal Facility Agreement and Consent Order (FFA/CO) WAG 9 is divided into four OUs. These OUs are further divided by release sites and are identified by site code in the FFA/CO (Figure 2-2). There are 38 release sites which include the industrial waste pond and three ditches, the Main Cooling Tower Blowdown ditch, the north ditch, the EBR-II leach pit, the ANL-W open burn pits, the interceptor canal, other miscellaneous disposal systems and accidental releases of hazardous substances. Information and data for these sites provided the input for the site screening and data gap analysis. Table 2-1 summarizes release site descriptions, COPCs, data available, associated, known or potential data gaps, and references. Data gaps which could preclude the completion of the 9-04 RI/FS are identified in the following operable unit summaries, as appropriate. Available data for the release sites that are retained for evaluation in the risk assessment are presented in Appendix A. Because data quality, as presented in a precision, accuracy, representativeness and completeness section, was presented in the individual site assessment reports (e.g., Track 2 Summary Report), no further presentation of data quality is presented herein.

2.2.1 OU 9-01

This consists of the following 10 miscellaneous sites.

2.2.1.1 Sanitary Sewage Lagoons (ANL-04)

The sanitary sewage lagoons are located at the Sanitary Sewage Treatment Facility, north of the ANL-W facility. Two lagoons were constructed in 1965 along with a third built later in 1974. According to engineering drawings, the three sanitary sewage lagoons cover approximately two acres. With references to ANL-W Plot Plan located at the beginning of this document, the lagoons' approximate dimensions are: (#1)—46 × 46 × 2.1 m (150 × 150 × 7 ft), (#2)—15 × 30 × 2.1 m (50 × 100 × 7 ft), and (#3)—38 × 122 × 2.1 m (125 × 400 × 7 ft). The lagoons receive all sanitary wastes originating at ANL-W, with the exception of the Transient Reactor Test Facility and the Sodium Components Maintenance Shop. Sanitary waste

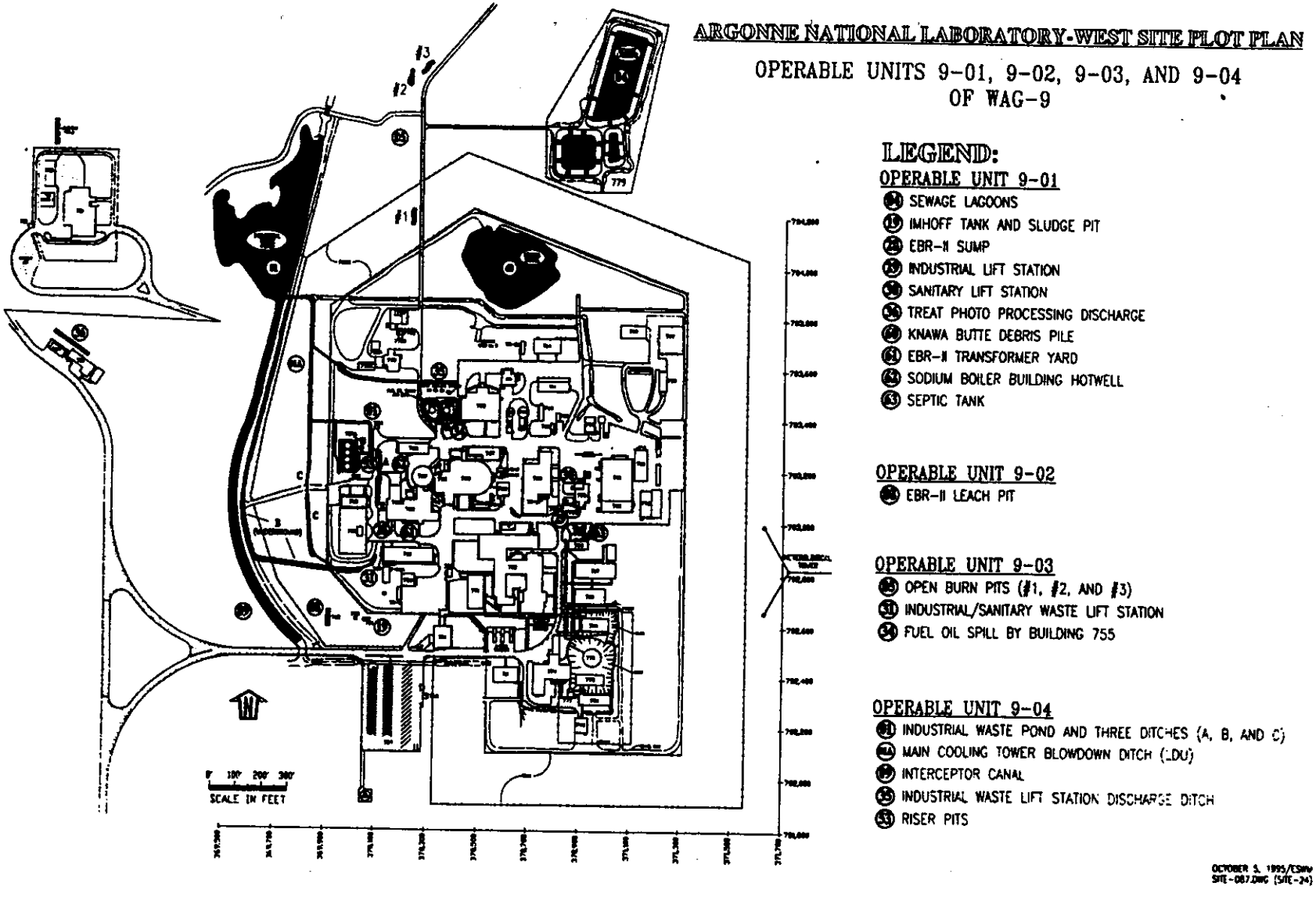

Figure 2-2 ANL-W Release Sites

A larger pullout 11 x 17-inch map is the first map in Appendix B.

Table 2-1 Summary of data available for potential release sites within ANL-W (WAG 9).

	Site	Site Description	COPCs	Data available	Potential or known data gaps	Source of information
None	ANL-10	Dry Well between T-1 and ZPPR Mound	None	Interviews with facility personnel indicate that the dry well was hooked up to a septic tank which was removed in 1966. Therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986).
None	ANL-11	Waste Retention Tank 783	None	Interviews of former facility operators indicate that no hazardous constituents were ever disposed at the tank; Therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W 1986), Summary Assessment Report (ANL-W, 1990a).
None	ANL-12	Suspect Waste Retention Tank by 793	None	Interviews of former facility operators indicate that the tank was removed in 1979 and that no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1990b).
None	ANL-14	Septic Tank and Drain Fields (2) by 753	None	Process knowledge and interviews with plant services personnel indicate that the only materials disposed were trace quantities of cleaning supplies. The tank was removed in 1979 and no source exists.	None	Initial Assessment Report for WAG 0 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1990a).
None	ANL-15	Dry Well by 768	None	Process knowledge and interviews with facility personnel indicate that the only hazardous constituent disposed was hydrazine.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1987).
None	ANL-16	Dry Well by 759 (2)	None	Process knowledge and interviews with facility personnel indicate that the only hazardous constituent disposed was hydrazine.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1987).

Table 2-1 (continued).

	Site	Site Description	COPCs	Data available	Potential or known data gaps	Source of information
None	ANL-17	Dry Well by 720	None	Process knowledge and interviews with facility personnel, no hazardous constituents were ever disposed and therefore no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1989).
None	ANL-18	Septic Tank and Drain Field by 789	None	The septic tank and drain field were removed in 1979. Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986).
None	ANL-20	Septic Tank and Drain Field by 793	None	Engineering drawings, and interviews with employees indicate no hazardous constituents were disposed and therefore no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1988).
None	ANL-21	TREAT Suspect Waste Tank and Leaching Field (Non-radioactive)	None	Process knowledge and interviews with plant services personnel indicate that the only materials disposed were trace quantities of cleaning supplies, therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1990a).
None	ANL-22	TREAT Septic Tank and the current Leaching Field	None	Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site; therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986).
None	ANL-23	TREAT Seepage Pit and Septic Tank West of 720	None	Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site. The tank was filled with sand in 1980; therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986).

Table 2-1 (continued).

	Site	Site Description	COPCs	Data available	Potential or known data gaps	Source of information
None	ANL-24	Lab and Office Acid Neutralization Tank	None	Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site. Therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986).
None	ANL-25	Interior Building Coffin Neutralization Tank	None	After neutralization with sodium hydroxide, the liquid was transferred to the retention tank. Thus, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1990a).
None	ANL-26	Critical Systems Maintenance Degreasing Unit	None	The degreasing unit is self-contained and is inside another building. No evidence exists (from spill records and interviews) of any hazardous constituents being spilled. All wastes are collected by a commercial vendor, therefore no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1990a).
None	ANL-27	Plant Services Degreasing Unit	None	The degreasing unit is self-contained and is inside another building. No evidence exists (from spill records and interviews) of any hazardous constituents being spilled. All wastes are collected by a commercial vendor; therefore no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1989).
None	ANL-32	TREAT Control Building 721 Septic Tank and Leach Field (Present)	None	Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site; therefore, no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1988).

Table 2-1 (continued).

	Site	Site Description	COPCs	Data available	Potential or known data gaps	Source of information
None	ANL-33	TREAT Control Building 721 Septic Tank and Seepage Pit	None	Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site. The tank was removed in 1978 and no source exists.	None	Initial Assessment Report for WAG 9 (ANL-W, 1986), Summary Assessment Report (ANL-W, 1988).
9-01	ANL-04	ANL Sewage Lagoons	Metals and radionuclides	Sludge samples were collected in 1994 and analyzed for metals and radionuclides.	Yes	Track 1 Decision Documentation Package (ANL-W, 1995a).
9-01	ANL-19	Sludge Pit West of T-7 (Imhoff Tank)	None	Engineering drawings indicate that industrial wastes and laboratory process wastes were discharged to a separate waste piping system. The tank was filled with dirt in 1978. Therefore no source exists.	None	Track 1 Decision Documentation Package (RUST Geotech, 1994a).
9-01	ANL-28	EBR-II Sump	Sulfuric acid and hexavalent chromium	Based on water chemistry results, the hexavalent chromium was reduced to trivalent chromium and the pH of the liquid discharged typically ranged between 4-11.	None	Track 1 Decision Documentation Package (RUST Geotech, 1994b).
9-01	ANL-29	Industrial Waste Lift Station	Silver	Sludge samples were collected in 1986, 1990, and 1995 and analyzed for silver.	None	Track 1 Decision Documentation Package (ANL-W, 1995b).
9-01	ANL-30	Sanitary Waste Lift Station	Silver	Process knowledge, review of historical records, and drawings indicate there was a release of silver to the site.	None	Track 1 Decision Documentation Package (ANL-W, 1994a).
9-01	ANL-36	TREAT Photo Processing Discharge Ditch	Silver	Soil samples were collected in 1987 and analyzed for silver.	None	Track 1 Decision Documentation Package (RUST Geotech, 1994c).

Table 2-1 (continued).

	Site	Site Description	COPCs	Data available	Potential or known data gaps	Source of information
9-01	ANL-60	Knawa Butte Debris Pile	None	Process knowledge of where the soil and debris was moved from indicate there is no source at the site.	None	Track 1 Decision Documentation Package (ANL-W, 1994b).
9-01	ANL-61	EBR-II Transformer Yard	PCBs	Analytical results from the soil at this site during removal of the transformers.	None	Track 1 Decision Documentation Package (RUST Geotech, 1994d).
9-01	ANL-61A	PCB-contaminated soil adjacent to ANL-61	PCBs	Analytical results from the soil at this site during removal of the transformers.	Yes	Track 1 Decision Documentation Package for ANL-61 (RUST Geotech, 1994d).
9-01	ANL-62	Sodium Boiler Building (766) Hotwell	None	Process knowledge and interviews with facility personnel indicate that the only hazardous constituents disposed were hydrazine and tritium.	None	Track 1 Decision Documentation Package (ANL-W, 1994c).
19-01	ANL-63	Septic Tank 789-A	None	Process knowledge and interviews with facility personnel indicate that no hazardous constituents were disposed at the site. Therefore no source exists.	None	Track 1 Decision Documentation Package (RUST Geotech, 1994e).
9-02	ANL-08	EBR-II Leach Pit (Radioactive)	Radionuclides, metals, dioxins, and semivolatile organic compounds	Analytical results from sludge soil and basalt and groundwater samples collected in 1991 and 1993.	Yes	9-02 Track 2 Summary Report (RUST Geotech, 1994b).
9-03	ANL-05	ANL Open Burn Pits #1, #2, and #3	Metals, radionuclides, VOCs, PAHs, and dioxins/furans	Site inspections, historical records, and analytical results from soil samples collected in 1988 and 1994.	None	Revised 9-03 Track 2 Summary Report (ANL-W, 1995c).
9-03	ANL-31	Industrial/Sanitary Waste Lift Station (Industrial Side Not Used)	Metals and radionuclides	Historical operational knowledge and analytical results of the sampling conducted in 1995.	None	Revised 9-03 Track 2 Summary Report (ANL-W, 1995c).

Table 2-1 (continued).

	Site	Site Description	COPCs	Data available	Potential or known data gaps	Source of information
9-03	ANL-34	Fuel Oil Spill by Building 755	Fuel Oil (benzene/ naphthalene)	Modeling results based on the estimated volume of the fuel oil spill.	None	Revised 9-03 Track 2 Summary Report (ANL-W, 1995c).
9-04	ANL-01	Industrial Waste Pond and Cooling Tower Blowdown Ditches (3)	Metals, radionuclides, VOCs, and herbicides	Analytical results from soil, sludge, and water samples at the IWP collected in 1986, 1987, 1988 and 1994 and analytical results from soil samples collected at the ditches in 1988 and 1994.	Yes	Revised Preliminary Scoping Package (ANL-W, 1995d).
9-04	ANL-01A	Main Cooling Tower Blowdown Ditch	Metals, radionuclides, and semivolatile organic compounds	Analytical results from soil samples collected in 1987, 1988 and 1994.	Yes	Revised Preliminary Scoping Package (ANL-W, 1995e).
9-04	ANL-09	ANL Interceptor Canal	Metals and radionuclides	Analytical results from soil samples collected in 1994.	None	Revised Preliminary Scoping Package (ANL-W, 1995f).
9-04	ANL-35	Industrial Waste Lift Station Discharge Ditch	Metals, radionuclides, VOCs, and dioxin/furans	Analytical results from soil samples were collected in 1988 and 1994 and analytical results from water samples collected in 1988.	None	Revised Preliminary Scoping Package (ANL-W, 1995g).
9-04	ANL-53	Cooling Tower Riser Pits	Metals	Analytical results from soil samples collected in 1989.	None	Preliminary Scoping Package (ANL-W, 1993).

discharged is from rest rooms, change facilities, drinking fountains and the Cafeteria. The three lagoons are sealed with a 0.32–0.63 cm (0.125–0.25 in.) bottom bentonite liner and are situated approximately 183 m (600 ft) above the groundwater.

A large leak in the northeast corner of the third lagoon was detected after its construction in 1974. This leak resulted in the loss of over a million gallons of waste water through fissures that were not sealed completely by the bentonite. This was rectified by using a 30 mil hypalon liner over the northeast corner and sealing the seams. A study in 1992 (Braun, 1992) confirmed that the Sanitary Lagoons are functioning as evaporative ponds and not as percolating ponds, suggesting that the bentonite and hypalon liners have remained intact.

Between 1975 and 1981, photo processing solutions were discharged from the Fuel Assembly and Storage Building to the Sanitary Waste Lift Station, which discharges to the lagoons. The manager of Fuel Assembly and Storage Building during that period, estimates that approximately 1.32 Troy ounces of silver were discharged to the Sanitary Waste Lift Station. It has not been confirmed whether the silver was released to the sanitary lagoons or if it remained in the lift station. However, risk-based calculations show that the estimated silver concentration (68 mg/kg) for the given amount (1.32 Troy oz.) is well below that required to exceed a risk greater than 1×10^{-6} (327 mg/kg). Furthermore, photo processing was discontinued at the Fuel Assembly and Storage Building in 1981 and subsequently, there have been no further releases to the lift station, or subsequently the sewage lagoons. With the exception of an occasional point source of low level medical radionuclides, there has been no known radioactive hazardous substances released into the Sewage Lagoons. Periodic sampling of the Sewage Lagoon and a radionuclide detector placed in the lift station (Sanitary Waste Lift Station-788) supplying the Sewage Lagoons support these conclusions. However, because no prior sludge samples were analyzed for metals and radionuclides, seven sludge samples were collected in 1994. The results from this sampling were used in a Track 1 risk evaluation in 1995 (ANL-W, 1995a) which indicates that the maximum concentrations of arsenic and chromium (i.e., 10.4 mg/kg and 76.4 mg/kg, respectively) exceed risk-based soil concentrations (i.e., 0.366 mg/kg and 24.9 mg/kg, respectively). This assumes that all the chromium is hexavalent chromium.

A data gap was identified by the EPA and IDHW to model the loss of 1 million gallons of water from the sewage lagoons. ANL-W has evaluated the one million gallon loss of sanitary waste with an estimated three percent solids from the sanitary lagoon and has determined that a data gap does not exist. The sewage lagoon was just being put into service when the leak occurred and the water loss was only sanitary sewage. At the time the leak occured, there was no sludge buildup in the newly constructed lagoon to present a source of contamination for the sanitary discharge. The leak also occurred before the discharge of photo processing solutions to the sanitary system began. The results of 1994 sampling of sludge also indicated that metal levels did not pose a risk to groundwater. The contaminants in the raw water released are not known. Therefore, the source term for model calculations is not known. Furthermore, the release was sanitary waste water so the presence of coliform bacteria in down gradient wells should indicate any impact to the aquifer. To date samples of the two ANL-W down gradient production wells have never detected coliform bacteria.

2.2.1.2 Sludge Pit W of T-7 (Imhoff Tank) (ANL-19)

The Imhoff Tank and sludge pit collected sanitary waste from the power plant (Bldg. 768), the Fuel Cycle Facility (Bldg. 765), the Laboratory and Office building (Bldg. 752) and the Fire House (Bldg. 759). The Imhoff Tank was used to settle out the sanitary wastes from 1963 to 1966. After settling, the sludge from the Imhoff Tank was pumped to the adjacent sludge pit. Liquid effluent from the Imhoff Tank was discharged to the EBR-II Leach Pit, approximately 61 m (200 ft) to the west. The Imhoff Tank was approximately 3.7 × 7.3 × 5.5 m (13 × 24 × 18 ft). The sludge pit was a 0.9 m (3 ft) diameter by 3.7 m (13 ft) tall vertical cylinder located 1.5 m (5 ft) south of the Imhoff Tank. Engineering drawings indicate that all industrial wastes and laboratory chemicals were discharged separately through industrial waste lines that bypassed the Imhoff Tank/sludge pit. It is unlikely that hazardous constituents were disposed of in the Imhoff Tank and sludge pit. The Imhoff Tank and sludge pit were cut down to 0.3 m (1 ft) below grade and filled with dirt in 1978. Because no potential source of hazardous materials is known to be associated with this site, no comparison with risk-based concentrations was conducted in the Track 1 DDP (RUST Geotech, 1994a).

Based on the condition of the tank, a No Further Action Determination was recommended and signed by the Remedial Project Managers (RPMs) in the Track 1 Decision Documentation Package.

2.2.1.3 EBR-II Sump (ANL-28)

The EBR-II Sump is a 2,500 L (660 gal) underground coated carbon steel tank, 1.5 m (5 ft) in diameter by 1.4 m (4.5 ft) in depth located just southwest of the Power Plant (Bldg. 768). The Sump is believed to have been installed in the early 1970s and is currently in use. The tank is a centralized collection facility for cooling tower blowdown, ion exchange regeneration effluent and small quantities of laboratory chemicals from the water chemistry laboratory in the Power Plant before discharging via a pipe to the Main Cooling Tower Blowdown Ditch. Currently, the Power Plant is not operating and ANL-W is circulating water in the cooling tower basin to prevent it from freezing.

The sump was originally used to raise the pH of low-pH water derived from the cooling tower blowdown wastewater. Prior to 1980 hexavalent chromium was used as a corrosion inhibitor and hence, low levels of chromates were discharged through the sump, although this hexavalent chromium was chemically modified to trivalent chromium, thus resulting in low-pH waste water. The pH of waters discharging through the sump is typically between 6 and 9, but it can vary between 4 and 11. A neutralization tank was installed inside the Power Plant in 1985 to ensure that the pH of discharged waters stays between 4 and 11.

Since 1980, a phosphate-based corrosion inhibitor was used instead of hexavalent chromium. Chromates have not been discharged through this sump since July 1980. The caustic injection system and pumps have since been removed from the sump, and wastewater currently flows directly through the sump to an underground pipe that discharges at the Main Cooling Tower Blowdown Ditch. Total discharges through the sump are estimated at 438 million gallons over 23 years. No sludges or sediment remain at the bottom of the tank.

Because no potential source of hazardous materials is known to be associated with this site, no comparison with risk-based concentrations was conducted in the Track 1 DDP (RUST Geotech, 1994b). Therefore, a No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.1.4 Industrial Waste Lift Station (ANL-29)

The Industrial Waste Lift Station was installed on the east side of the ANL-W site in 1972. It receives the industrial waste effluents from the Zero Power Physics Reactor support wing (Bldg. 774), the Lab and Office Building (Bldg. 752), the EBR-II Engineering Laboratories (Bldgs. 772 and 789) and the Fuel Manufacturing Facility (Bldg. 704). The waste effluents from these facilities are then discharged, from the lift station to the Industrial Waste Lift Station Discharge Ditch (ANL-35), also known as the North Ditch, which is located north of the Hot Fuel Examination Facility. The only contaminant of potential concern identified from process knowledge of water released to the Industrial Waste Lift Station is silver. Sludge samples collected in 1986 from the Industrial Waste Lift Station detected silver at 23,700 mg/kg. Silver recovery units were installed on photo processing units at ANL-W in September 1986 and solutions containing silver were not allowed to be directly discharged into the industrial waste systems. However, on October 3, 1990, photo processing solution was inadvertently discharged directly into the Industrial Waste Lift Station, bypassing the silver recovery units installed at the EBR-II Engineering Laboratory (Bldg. 772). Sludge samples collected in 1990 indicate 28 mg/kg of total silver. In 1990, the silver recovery units throughout ANL-W were modified and operating procedures were updated to prevent any further silver releases. A Track 1 investigation was originally performed for this site and based on the above information it was determined that the potential health risks are less than the lower limit of the NCP target risk range. A No Further Action Determination was recommended for the site but was never finalized. Additional sludge samples were collected from the bottom of the lift station in 1995 and analyzed for total silver, TCLP silver and gamma spectrometry. Results of the gamma spectrometry indicate that Cs-137 was detected at a maximum concentration of 8.7 pCi/g. However, this sludge is located 4.6 m (15 ft) below ground surface and the only complete exposure pathway is groundwater of which this value is less than the risk-based concentration. The maximum detected soil concentration of silver is 5,400 mg/kg and this concentration does not result in a potential health risk greater than the lower limit of the NCP target risk range (ANL-W, 1995b).

Because the potential health risk associated with silver at this site is less than the lower limit of the NCP target risk range, a No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.1.5 Sanitary Waste Lift Station (ANL-30)

The Sanitary Waste Lift Station (Bldg. 778) was built in 1965. It receives all sanitary waste originating at ANL-W, with the exception of the Transient Reactor Test Facilities (Bldgs. 720, 721, 722, 724, and T-15) and the Sodium Components Maintenance Shop (Bldg. 793). The Sanitary Waste Lift Station, which consists of a sump approximately 1.8 m (6 ft) in diameter and 4.9 (16 ft) deep, discharges to the Sanitary Sewage Lagoons (ANL-04). Between 1975 and 1981, photo processing solutions were discharged from the Fuel Assembly and Storage Building

to the Sanitary Waste Lift Station. The manager of Fuel Assembly and Storage Building during that period, estimates that approximately 1.32 Troy ounces of silver were discharged to the Sanitary Waste Lift Station. Photo processing was discontinued at the Fuel Assembly and Storage Building in 1981 and consequently, there have been no further releases to the Sanitary Waste Lift Station. Silver, and low-levels of medical radionuclides are the only hazardous constituents potentially discharged to the lift station.

Because the maximum detected silver concentration (68 mg/kg) were less than the lowest risk-based soil concentration across all exposure pathways (1,350 mg/kg) (ANL-W, 1994a), a No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.1.6 TREAT Photo Processing Discharge Ditch (ANL-36)

The Transient Reactor Test (TREAT) Photo Processing Discharge Ditch is located approximately 6.1 m (20 ft) northeast of and parallel to the Photo Lab (Bldg. 724) and the TREAT Office Building (Bldg. 721). The ditch is actually a very shallow [i.e., 15 cm (6 in.)] linear depression approximately 165 m (540 ft) long by approximately 1.8 m (6 ft) wide. Approximately 1,500 L (400 gal) of photo processing solutions are estimated to have been discharged to the ditch over the two year period from 1977–1979. It is unlikely that the photo processing solutions actually had an impact on the entire length of the ditch because of the small volume of solutions discharged to the ditch at any one time, and the relatively short length of time it was used. Wastes discharged to the ditch were generated in the Photo Lab. In 1987, twenty soil samples were collected from the ditch and qualitatively screened by x-ray spectrometry. Of these twenty soil samples, three were analyzed for total silver.

Because the maximum detected silver concentration (17 mg/kg) was less than the risk-based soil concentration (RUST Geotech, 1994c), a No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.1.7 Knawa Butte (ANL-60)

The Knawa Butte is located due north of the Hot Fuel Examination Facility-North (Bldg. 785) near the security fence. As ANL-W began to expand, previously undisturbed areas within the security perimeter became the site for new facilities. Miscellaneous construction debris, including refuse concrete and rocks and dirt from the excavation of the Hot Fuel Examination Facility and the Experimental Breeder Reactor-II (Bldg. 767) basements were disposed of at Knawa Butte. The butte was used as a construction refuse pile until September 1972, when a service request was made to renovate the existing pile and convert it to a doughnut-shaped mound.

The butte continued to be utilized as a disposal area until October 1975, when it was decided, because of tightened security control, that construction refuse should be disposed of elsewhere. ANL-W personnel concluded that future excavation material (i.e., rock and dirt) would be dumped into a man-made depression, which developed during construction of the Zero Power Physics Reactor mound, located approximately 457 m (1,500 ft) south of ANL-W. The

butte was then covered with clean soil and planted with grasses to aid the ecological recovery of the area. During May of 1986, a security bunker was installed in the northern-most section of the butte. The bunker was used to store ammunition and continues to be utilized by ANL-W Security today. In September of 1992, several three feet deep holes were dug in the Knawa Butte that verified that its contents were actually excavation and construction debris. Because no potential source of hazardous constituents is known to be associated with this site, no comparison with risk-based concentrations was conducted in the Track 1 DDP (ANL-W, 1994b).

Because no sources of hazardous constituents exist at this site, a No Further Action determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.1.8 EBR-II Transformer Yard (ANL-61)

The EBR-II Transformer Yard located south of the EBR-II Power Plant (Bldg. 768) is the site of PCB and diesel fuel contamination. The PCB contamination is due to historic (i.e., prior to 1978) leakage from four transformers. All four transformers were replaced and the majority of the contaminated soil was removed during a clean-up action from 1988 through 1992. Approximately 54 m^3 (70 yd^3) of PCB-contaminated soil was removed and transported to an offsite disposal facility. The concrete pads supporting the transformers were solvent cleaned, etched and coated with epoxy resin as a temporary mitigation measure. Additional soil sampling was performed in 1991 and an additional 386 m^3 (505 yd^3) of PCB-contaminated soil and concrete were removed in 1992. One hundred and sixty-six verification soil samples were collected in 1992. Three of these verification soil samples had PCB concentrations greater than the Toxic Substances Control Act Action Limit of 25 mg/kg. These soil samples were collected directly below Transformer #3 and directly above the basalt at approximately 2.3–2.4 m (7.5–8.0 ft) below ground surface. At these locations, the soil was removed to bedrock and a bentonite barrier was placed directly above the basalt. The area was then backfilled with clean soil and new transformers installed. Thirty-eight additional verification soil samples were collected in a ditch south of the transformer yard. Two of the soil samples has PCB concentrations greater than the 25 mg/kg action limit. Therefore, fourteen verification soil samples were collected in this area. Two soil samples had PCB concentrations above the action limit. The soil was removed and 12 additional verification samples were collected. Those 12 soil samples had PCB concentrations below the action limit. Six soil samples were collected east of the transformer yard. Two soil samples located near an underground storage tank had PCB concentrations of 55 mg/kg and 39 mg/kg. None of the soil samples had PCB contamination greater than the risk-based concentration (RUST Geotech, 1994d).

A No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package pending removal of the last section of PCB-contaminated soil. However, because this soil near the underground storage tank has not been removed and no risk evaluation has been performed for this area of contaminated soil, it is identified as a new site (ANL-61A) and is discussed in Step 2, Section 2.3.

2.2.1.9 Sodium Boiler Building Hotwell (ANL-62)

The Sodium Boiler Building (Bldg. 766) condensate hotwell, built in 1962, is located north of the EBR-II Power Plant (Bldg. 768). This hotwell, which is identical to the EBR-II Power Plant condensate hotwell (Bldg. 768), receives water from the steamtrap and condensate drains. Water contained in the Sodium Boiler Building Hotwell sump is pumped back into the system instead of being discharged to the environment.

The boiler feedwater treatment program, from initial startup to September 1986, utilized a 35% solution of hydrazine as an oxygen scavenger and morpholine as a neutralizing amine. In September 1986, the treatment program was modified and now uses a carbohydrazide as an oxygen scavenger and a blended neutralizing amine (dimethylisopropanolamine and aminomethylpropanol). Tritium, produced in the EBR-II Reactor, migrates through the evaporator and superheater tube walls to the steam system. The level of the tritium in the condensate averages about 10^{-5} μCi/mL, which is below the DOE Order 5480.11 limits on effluent discharge of radionuclides to the environment of 3×10^{-3} μCi/mL. To verify there has been no migration of tritium from the condensate to the groundwater table, tritium analyses were performed on a monthly basis until November 1995, when it was changed to a quarterly basis on groundwater from the two production wells at ANL-W. Tritium has not been detected.

The total discharge of hydrazine from the Sodium Boiler Building hotwell is less than 4 mg/year during normal operation. Although trace quantities of hydrazine are present in the condensate, these minute amounts will scavenge oxygen in the hotwell or the industrial waste feeder ditch and be consumed. Because neither of the hazardous constituents believed to have been present at the site were detected no comparison with risk-based concentration was made in the Track 1 DDP (ANL-W, 1994c).

Because no hazardous constituents have been identified as being present at this site, a No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.1.10 Septic Tank 789-A (ANL-63)

This septic tank is located approximately 18 m (60 ft) northeast of the Equipment Building (Bldg. 789-A) and was believed to have been installed in the late 1950s. No buildings currently discharge to the septic tank and it was not shown on any ANL-W engineering drawings. An employee who worked at ANL-W in 1961 reported that construction trailers located near the septic tank were being dismantled and moved at that time. The septic tank was not in use and the outer ANL-W fence was located approximately 33 m (100 ft) to the west of the tank/trailers. Therefore, it is assumed that the septic tank only received sanitary waste effluent from the temporary construction trailers prior to the beginning of operations at ANL-W. The tank was inadvertently discovered in 1986 when a fire hydrant in the vicinity was being replaced. It is reported that there was fluid in the tank and a sample was collected for radioactive analysis. The analytical results are reported to have indicated no radioactive contamination, although the actual laboratory results can not be located. Because no potential source of hazardous materials is

known to be associated with this site, a comparison with risk-based concentrations was not conducted in the Track 1 DDP (RUST Geotech, 1994e).

Because this septic tank did not receive any hazardous constituents a No Further Action Determination was recommended and signed by the RPMs in the Track 1 Decision Documentation Package.

2.2.2 OU 9-02

OU 9-02 consists of one site, the EBR-II Leach Pit (ANL-08). In addition, the inlet pipe to the leach pit from ANL-31 (OU 9-03) is discussed in Section 2.1.2.3.2. The EBR-II Leach Pit is located between the inner and outer security fences in the southwest corner of the ANL-W facility. The pit is an irregularly shaped, unlined underground basin approximately 5.5 m (18 ft) wide by 12 m (40 ft) long; the bottom of the Leach Pit is 4.6 m (15 ft) below ground surface. The Leach Pit was excavated into basalt bedrock in 1959 with explosives. A 20 cm (8 in.) thick reinforced-concrete slab lid was installed 1.5 m (5 ft) below land surface and covered with native soil to prevent ingress of wildlife and precipitation.

Initially, the pit received all of the liquid industrial waste including cooling tower blowdown, sanitary effluent, cooling condensates and radioactive effluent generated at the ANL-W facilities. Discharge of industrial waste ceased following construction of the industrial waste pond in 1962. Sanitary-waste discharge to the Leach Pit ceased when ANL-W completed the sanitary lagoons in 1965. Although the radioactive liquid-evaporation system was completed in 1971[1] ANL-W used the Leach Pit for subsurface release of low-level radioactive effluent until 1973. The average annual discharge to the Leach Pit was approximately 9×10^4 gallons from 1960 to October 1973, containing a total of 10.4 curies of radioactivity (LATA 1990a). The residual curies remaining if all the radionuclides were in the Leach Pit would be 1.64 curies in 1994 (RUST Geotech, 1994f).

According to Volume II of the *Monitoring, Analysis, and Test (MAT) Plan* (LATA, 1990b) the Laboratory and Office (L&O) building was the primary generator and collection point for liquid waste suspected of containing radioactive constituents. The majority of the wastes were produced in the L&O building chemistry laboratories, the Hot Fuels Examination Facility-North and the Hot Fuels Examination Facility-South (HFEF-S). The Fuel Assembly and Storage Facility, the HFEF-S truck lock, the Building 768 change room, the component cleanup facility and the Zero Power Physics Reactor generated minor amounts of liquid radioactive waste and transferred those wastes to a receiving tank in the L&O building via a tanker truck; those wastes were ultimately discharged to the Leach Pit.

There are no records to indicate the types or quantities of nonradioactive contaminants that may have been discharged to the Leach Pit prior to startup of the industrial waste pond (LATA, 1990b). However, because the laboratory and office building chemical laboratories were

[1]Stewart, N., 1993, Argonne National Laboratory-West, Personal Communication with D. J. Haley, November 16.

the primary contributor of waste, it is assumed that organic chemicals, solvents, and metal-bearing wastes were discharged to the Leach Pit.

The pit was only used once since 1973. In November, 1975, tritiated water that exceeded the Energy Research and Development Administration (ERDA, now the Department of Energy) standards governing discharge to an uncontrolled area was discharged to the pit. Following that discharge, the pit was isolated from the liquid waste processing system by cutting the line at building 762 (LATA 1990a and ANL-W 1990).

Cooling tower blowdown containing trivalent or hexavalent chromium was a significant component of the nonradioactive industrial waste water discharged from 1962 to 1973; however, nonradioactive industrial waste water was only discharged to the Leach Pit in early 1962, prior to startup of the industrial waste pond (ANL-W 1973). In September, 1993, the Leach Pit was excavated so that the lid and the residual sludge could be removed thus removing the source of contamination; approximately 1/16 in. of residual sludge remaining on the Leach Pit floor at the completion of the removal action.

In 1991, as part of a Track 2 investigation soil samples were collected from the leach pit, the interbeds below the leach pit and surface locations in the leach pit and a groundwater sample was collected from a well drilled downgradient from the leach pit. Groundwater and soil samples were analyzed for VOCs, semivolatile organic compounds, metals, radionuclides, anions and pH. The results indicate the sludge samples in the leach pit and the soil samples collected below the leach pit in the interbeds had contamination. Results from the Track 2 type risk assessment indicate that cadmium concentrations exceed the TCLP limit and are considered hazardous waste. A Track 2-type risk assessment was performed which indicated that OCDD detected in the groundwater presents a potential risk of 1E-06, or at the lower limit of the NCP target risk range. Groundwater concentrations of other constituents did not exceed the risk-based levels. Soil concentrations of metals also are below levels which are indicative of potential adverse health effects. Cs-137, Co-60, Sr-90, and I-129 soil concentrations exceed threshold concentrations established for decontamination and decommissioning of INEL sites (EG&G, 1986), but fall below the lower limit of the NCP target risk range. Based on the results of this investigation the overburden and lid were removed in the fall of 1993 as part of a removal action conducted under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended. The majority of the sludge was removed in December 1993, the bottom of the Leach Pit was lined with 5 to 7 cm (2–3 in.) of bentonite clay and backfilled to grade. Samples were collected from the basalt. A risk evaluation performed on the concentration of the COPCs in the basalt and in the remaining sludge indicates that the total potential risk is 6E-06 from ingestion of groundwater contaminated with beryllium and Np-237, which is at the lower limit of the NCP target risk range (i.e., 10^{-6}) (RUST Geotech, 1994f).

A Track 2 Summary Report was completed and signed by the RPMs that recommends a removal action. In the summary report following the removal action, ANL-W stated that the groundwater flow pattern in the vicinity of the leach pit would be addressed in the WAG 9 comprehensive RI/FS, in addition to the effects from exposure to the contaminants in the inlet pipe.

2.2.3 OU 9-03

OU 9-03 consists of the following three miscellaneous sites.

2.2.3.1 ANL Open Burn Pits #1, #2, and #3 (ANL-05)

Three abandoned open burn pits are located at ANL-W. Two of the pits (#2 and #3) are located side by side approximately 91 m (300 ft) north of the north security fence and pit #1 is located between the north security fences. The pits were initially used to burn construction wastes, such as paper and wood as early as 1960. In addition, approximately 150 gals of organic wastes from analytical chemistry operations were disposed of in the burn pits from 1965-1970. The exact locations of where the organic compounds were dumped is not known. These organic laboratory wastes were collected in 5-gal glass carboys that were emptied into the pits prior to scheduled burns. After a burn the pits were covered with a layer of native soil. Interviews with employees who worked at the site at the time indicate that approximately 25–30 gals per year of organic laboratory wastes were disposed in the pits over a 5-year period from 1965–1970, for a total of 150 gals. The organic wastes consisted primarily of toluene, xylene, hexane, isopropyl alcohol, butyl cellosolve, tributylphosphate and mineral oil. Mineral oil accounted for approximately 50% of the organic mixture. Random soil samples were collected from the burn pits in 1988 and 1994. Soil samples were analyzed for volatile and semivolatile organic compounds, metals, PCBs, pesticides, dioxin/furans and radionuclides. A preliminary risk assessment was performed which indicates that the potential risk from exposure to all contaminants detected is less than the lower limit of the NCP target risk range. Based on the results of the risk assessment no further action was recommended and signed by the RPMs in the revised 9-03 Track 2 Summary Report (ANL-W, 1995c).

2.2.3.2 Industrial/Sanitary Waste Lift Station (Bldg. 760) (ANL-31)

The Industrial/Sanitary Waste Lift Station (Bldg. 760) is actively used on the sanitary side, however the industrial side is inactive. Both the industrial and sanitary sides of the waste lift station are approximately 1.8 × 1.8 × 4.2 m (6 × 6 × 14 ft) reinforced concrete. No hazardous constituents have been identified as being routed through the sanitary waste side. Acids and bases identified in the Initial Assessment for the "ANL Interceptor Canal" were discharged through the industrial waste side of the lift station. In 1995, samples were collected from the water and sludge and were analyzed for metals and radionuclides. Results from a Track 2 risk assessment indicate that several radionuclides pose a potential risk at the lower limit of the NCP target risk range (ANL-W, 1995c). Therefore, a removal action was initiated to remove the source at this site (i.e., water, sludge, and piping) in November 1995. Piping from the Lift Station to the meter house was removed. The remaining 27 m (90 ft) of the piping from the meter house to the EBR-II Leach Pit is scheduled for removal in the summer of 1996. The removal of the piping will be completed by October 1, 1996 as a "housekeeping activity". ANL-W will notify the EPA and IDHW 14 days prior to the removal. After all sources of contamination was removed, the industrial side lift station was filled with concrete in March 1996. Therefore, a no further action was recommended and signed by the RPMs in the revised 9-03 Track 2 Summary Report (ANL-W, 1995c).

2.2.3.3 Fuel Oil Spill by Building 755 (ANL-34)

ANL-34 is the site of a 50-gallon spill of #5 fuel oil from an above-ground storage tank. The #5 fuel oil was heated in order for it to flow into the tank. A sight glass used as a control mechanism failed when a certain pressure was exceeded during filling. At the time of the spill, the tank was surrounded by a large earthen berm approximately 1.2 m (4 ft) high and 18.3 × 18.3 m (60 ft × 60 ft) square at the inside base of the berm. The spilled fuel oil occupied an area approximately 1.5 m × 6.1 m (5 ft × 20 ft) and was confined within the berm area. A risk assessment was performed on the most mobile (i.e., naphthalene) and the most hazardous (i.e., benzene) constituents of the fuel oil. The risk assessment indicates that the risk would be below the lower limit of the NCP target risk range. Based on this information, the revised OU 9-03 Track 2 Summary Report (ANL-W 1995c) recommends no further action and the summary report was signed by the RPMS.

2.2.4 OU 9-04

OU 9-04 consists of five sites. These sites are involved with the transport of surface water runoff, cooling tower blowdown water and other liquid waste disposal ditches to the Industrial Waste Pond.

2.2.4.1 Industrial Waste Pond and Three Cooling Tower Blowdown Ditches (ANL-01)

The Industrial Waste Pond (IWP) is an unlined, approximately 1.2 ha (3-acre) evaporative seepage pond fed by the Interceptor Canal and site drainage ditches. The pond was excavated in 1959, with a maximum water depth of about 4 m (13 ft), and is still in use today. During this time, the Cooling Tower Blowdown ditches have been rerouted several times. ANL-W auxiliary cooling tower blowdown ditches convey industrial wastewater from the EBR-II Power Plant and the Fire Station (Bldg. nos 768 and 759) to the Industrial Waste Pond. The IWP was originally included with the Main Cooling Tower Blowdown Ditch (MCTBD) as a Land Disposal Unit under the RCRA Consent Order and Compliance Agreement on the basis of potentially corrosive liquid wastes discharged with the cooling tower effluent. However, ANL-W conducted a field demonstration with the EPA and State of Idaho representatives in attendance in July 1988, that showed that any potentially corrosive wastes discharged to the IWP were neutralized in the MCTBD before reaching the IWP. On that basis, EPA removed the IWP as an Land Disposal Unit and re-designated it as a Solid Waste Management Unit. Therefore, this site is still under the regulatory authority of RCRA in addition to being on the FFA/CO and under the regulatory authority of CERCLA.

Currently, all three ditches (i.e., Ditches A, B, and C) discharge to the MCTBD, which then discharges to the IWP. Because of the physical separation of these ditches to the pond, each ditch and the IWP will be screened separately. Samples have been collected from the soil, sludge and water present in the IWP and soil samples have been collected from the ditches. These samples were analyzed for volatile and semivolatile organic compounds, metals, PCBs, pesticides, herbicides, dioxin/furans and radionuclides. Two risk assessments were performed at this site. Each risk assessment used different data (i.e., either pre or post 1994 data). Each risk assessment indicates that it is unlikely that exposure to the contaminants will cause adverse health effects.

However, the risk assessment using only the 1994 data only evaluated the soil ingestion exposure pathway (ANL-W, 1995d). Therefore, a data gap is evaluation of other exposure pathways in a risk assessment.

2.2.4.2 The Main Cooling Tower Blowdown Ditch (ANL-01A)

The Main Cooling Tower Blowdown Ditch (MCTBD) runs from the West side of the cooling tower north in between the security fence to the Industrial Waste Pond. It is an unlined channel approximately 213 m (700 ft) in length and 0.9 to 4.6 m (3 to 15 ft) wide. From 1962 to present the ditch has been utilized to convey industrial wastewater from the Cooling Tower to the Industrial Waste Pond. The main source of impurities to the Industrial Waste Pond was water treatment chemicals used to regenerate the ion exchange resin which removes minerals from cooling tower water used in the EBR-II steam system. From 1962 to July 1980, a chromate-based corrosion inhibitor was added to the Cooling Tower water. The blowdown contained significant quantities of hexavalent chromium. Ion exchange column regeneration discharges have occurred from 1962 to March 1986. Regeneration of these columns is accomplished with sulfuric acid for cation columns and sodium hydroxide for anion columns. A neutralization tank was installed from March–October 1986. A few discharges of regeneration water occurred, but they were in small batches and were monitored before discharge. Since October 1986, after the tank was installed, reagents are being neutralized in a tank prior to discharge to the pond.

In January 1986, a pH measurement of 1.86 was measured in the effluent discharged to the MCTBD. This classified the liquid wastes as corrosive according to 40 CFR 261.22. The site was then classified as a Land Disposal Unit under RCRA. In February 1986, pH measurements were taken at the outfall to the MCTBD at 10-minute intervals during a regeneration episode; over the 4-hour observation period, pH measurements at the outfall ranged between 1.6 and 2.0 for a total of approximately 40 minutes. A temporary neutralization system was installed in March and a permanent neutralization tank was installed in October 1986. In 1995, 21 soil samples were collected and analyzed for pH and soil buffering capacity. These measurements indicate that the pH in the soil ranged from 6.9 to 8.2 with the soil buffering capacity ranging from 26 to 165.

On October 19, 1995, a letter was submitted to the IDHW/DEQ from DOE requesting that this site be reclassified from a Land Disposal Unit to a Solid Waste Management Unit. The IDHW/DEQ responded in a letter dated December 18, 1995, and denied the request for removal of the LDU designation for the MCTBD. "The closure of the MCTBD will follow CERCLA under the FFA/CO process with RCRA closure requirements [IDAPA 16.01.05.008 (40 CFR 264 Subpart G)] being strictly applicable." After further review of the FFA/CO agreement ANL-W has determined that if the MCTBD does not pose a risk greater than those specified in the National Contingency Plan, the RCRA closure requirements will not be applicable.

Soil samples were collected in 1987, 1988, and 1994 and were analyzed for volatile and semivolatile organic compounds, PCBs, pesticides, herbicides, dioxin/furans, metals, and radionuclides. Two risk assessments were performed at this site. Each risk assessment used different data (i.e., either the pre or post-1994 data). As shown in ANL-W (1995e) a couple of

the metals indicated a risk greater than the lower limit of the NCP target risk range. The second risk assessment, performed using the 1994 data indicates that no COCs were identified based on a comparison of the maximum detected concentrations to risk-based soil concentrations based on the soil ingestion exposure pathway only. Therefore, a data gap is evaluation of the other exposure pathways in a risk assessment.

2.2.4.3 The ANL-W Interceptor Canal (ANL-09)

The ANL-W Interceptor Canal was utilized to transport industrial waste to the Industrial Waste Pond and to divert spring runoff and other natural waters around the ANL-W facility for flood control. Between 1962 and 1975, two 4-in. pipes transported liquid industrial wastes and cooling tower effluent to the Interceptor Canal. One line transported cooling tower blowdown water and regeneration effluent while the other line originated at the Industrial Waste Lift Station (Bldg. 760) and transported industrial wastes. Liquid radioactive wastes were discharged through the same line as the industrial wastes, but they were diverted to the EBR-II Leach Pit. Discharge of industrial wastes was discontinued in 1973 and discharge of cooling tower blowdown water was discontinued in 1975.

During clean out operations at the Interceptor Canal in October 1969, abnormal background radioactivity was detected. Wastewater was diverted to an adjacent parallel ditch and radioactive liquid waste was accidentally discharged, resulting in contamination to the surface soils of the adjacent ditch (ANL-01 Ditch B). Additional radiation surveys in 1969, 1973 and 1975 indicated that the entire length of the Interceptor Canal was contaminated. Approximately 3,471 m^3 (4,540 yd^3) of contaminated soil was identified. Approximately 139 m^3 (182 yd^3) was disposed at the RWMC from 1975 to 1976 and approximately remaining 809 m^3 (1,058 yd^3) of contaminated soil was removed and stockpiled on site (this stockpiled soil is being evaluated as part of the OU 10-04 ROD). The rest of the contaminated soil was left in place. Another survey conducted in 1993 indicated that two small areas had elevated readings above background. Therefore, additional soil sampling was performed in 1994. These soil samples were analyzed for metals and radionuclides.

For the majority of the metals that have maximum detected concentrations greater than background concentrations (i.e., arsenic, copper, lead, mercury and silver) the maximum detected concentrations are only slightly higher (i.e., less than a factor of two) than background concentrations. For the radionuclides with maximum detected concentrations greater than background (i.e., Am-241, Co-60, Cs-134, Cs-137, Sr-90 and U-238) and those that were collected at more than one depth (i.e., Am-241, Co-60, Cs-134 and Cs-137), all soil concentrations decreased with increased depth. A planer map of this area along with maps that show concentrations verses depth of arsenic, copper, lead, mercury, Co-60 and Cs-137 are at the end of Appendix B.

A Track 2 risk assessment was performed which indicates that the risk associated with exposure to arsenic (3E-04), Cs-137 (4E-04) and U-238 (4E-06) exceed the lower limit of the NCP target risk range (ANL-W, 1995f). Arsenic exceeds the lower limit of the NCP target risk range for the groundwater and soil ingestion exposure pathways, Cs-137 and U-238 exceed this limit for the external exposure pathway, and U-238 also exceeds this limit for the groundwater

ingestion exposure pathway. For the soil ingestion external exposure pathways, the risks for arsenic and Cs-137, respectively, exceeded the lower limit of the NCP target risk range for both the current occupational and 30-yr future residential exposure scenarios.

2.2.4.4 The Industrial Waste Lift Station Discharge Ditch (ANL-35)

The Industrial Waste Lift Station Discharge Ditch, also known as the North Ditch, is located inside the security fences. The ditch is approximately 152 m (500 ft) in length with a bottom width of 0.91–1.2 m (3–4 ft). At any one time, there is approximately 5–8 cm (2–3 in.) of water in the ditch. The ditch receives industrial waste from a variety of facilities at ANL-W. From 1959 through 1966 the North Ditch was part of a surface water runoff ditch. From 1966 to 1972 the North Ditch received industrial wastewater from the Instrument and Test Facility (Bldg. 772) and the Sodium Process Demonstration Facility (Bldg. 789). After 1972 when the Industrial Waste Lift Station (Bldg. 778A), ANL-29, was installed, the North Ditch received waste from this lift station. Currently, the North Ditch receives wastewater from industrial waste sources discussed above.

In 1988, soil was excavated from the North Ditch in an effort to relieve clogging in the ditch by cattails and weeds. Analysis of soil samples remaining in and excavated from the ditch indicate that all metals, except beryllium (5.8 mg/kg), were below risk-based soil concentration (3.89E-05 mg/kg). Although, it should be noted that this risk-based soil concentration is less than background concentration (3.0 mg/kg). In addition, low-concentrations of VOCs, dioxins/furans and herbicides were detected. The excavated soil was boxed and disposed of at the bulky waste landfill at the CFA in August 1993.

In 1994, additional soil samples were collected and analyzed for metals and radionuclides. The risk assessment performed using only the 1994 analytical results indicates that risks are at the lower limit of the NCP target risk range (i.e., 10^{-6}) for arsenic, hexavalent chromium, Cs-137 and U-238 (ANL-W, 1995g). For arsenic, the risks from exposure through soil ingestion in the occupational exposure scenario and through both soil and groundwater ingestion in the future residential exposure scenario are greater than this limit and for hexavalent chromium, the risks are greater than this limit for the inhalation of fugitive dust exposure pathway for both the current occupational and future residential exposure scenarios. For Cs-137 and U-238, the risks are greater than the lower limit of the NCP target risk range for the external exposure pathway for both the current occupational and future residential exposure scenarios.

2.2.4.5 The Cooling Tower Riser Pits (ANL-53)

The Cooling Tower Riser Pits are located approximately 3 m (10 ft) east of the Main Cooling Tower. Each of the four pits is approximately 3.7 m (12 ft) deep with 23–38 cm (9–15 in.) of soil covering the rock bottom. During winter shutdown periods of the Main Cooling Tower, the riser pipes must be drained to prevent damage caused by freezing and the riser pits are used to collect this discharge. Soil samples were collected in 1989 at each of the riser pits and the north and south discharge pipes and were analyzed for arsenic, chromium, hexavalent chromium, lead and mercury. The risk assessment performed in the Track 2 Preliminary Scoping Package

indicates that the risk to human health is less than the lower limit of the NCP target risk range (RUST Geotech, 1994g).

2.2.5 ANL-W Windblown Area (OU 10-06)

Areas of radioactive windblown contamination at all of the major facility areas (e.g., TAN, ICPP, ANL-W) were identified during an aerial survey in 1990. These areas of windblown contamination, along with nonwindblown radioactively contaminated soil were grouped into OU 10-06 and evaluated in the RI/FS for that operable unit (Jessmore et al., 1996). At the ANL-W, two windblown areas were identified. These areas are the TREAT area and the main facility at ANL-W. Soil samples were collected at both these facilities in 1993 and analytical results from soil samples collected by the Radiological and Environmental Sciences Laboratory (RESL which is now called the Foundation) were used to evaluate risk from exposure to contaminants at the site. Dose equivalent rate measurements were also collected to evaluate the external exposure pathway.

Screening of the maximum detected soil concentrations and dose equivalent rates at both areas indicate that the COPCs at the site are Cs-137, Pu-238 and Pu-239/240 at the main windblown area and Cs-137 and Sr-90 at the TREAT area. All dose equivalent rates are below background levels; therefore, the external exposure pathway was not evaluated. Exposure scenarios evaluated were the current occupational and the 30- and 100-year future residential. Exposure pathways evaluated for the current occupational exposure scenario were soil ingestion and inhalation of fugitive dust and for the future residential exposure scenarios the exposure pathways evaluated were soil ingestion, fugitive dust inhalation and food crop ingestion.

Risks from the current occupational exposure scenario were less than the lower limit of the NCP target risk range (i.e., 10^{-6}). The only risk in the 30-year future residential expsoure scenario greater than this limit is ingestion of food crops contaminated with Cs-137 at both the TREAT and main windblown areas. In the 100-year future residential exposure scenario, only Cs-137 at the main windblown area was evaluated because the maximum concentration detected exceeded the preliminary remediation goal presented in the feasibility study. The risk from food crop ingestion decreased in 100-years but still was at the lower limit of the NCP target risk range (2E-06).

In addition to human health, risks to ecological receptors was also evaluated and it is highly unlikely that the COPCs will cause adverse effects to populations of exposed ecological receptors.

2.3 Step 2 Add Newly-Identified and Unevaluated Sites

The following site has been identified as a possible area within WAG 9 that likely requires additional investigation as part of OU 9-04. This site is the remaining PCB-contaminated soil at ANL-61. PCB-contaminated soil remains on the eastern side of ANL-61 at concentrations (39 and 55 mg/kg) just above the Toxic Substances Control Act limit (25 mg/kg). This soil was originally planned to be removed during replacement of a diesel underground storage tank in 1995. However, this tank has not been replaced and the contaminated soil remains.

2.4 Steps 3-5 Eliminate No Action, No Source, and Low Risk Sites

In Step 3, sites for which a source did not exist were eliminated. These sites are those which are designated "no action" in the FFA/CO Action Plan and as a result, were not assigned to an OU, and those sites which were assigned to an OU, but where no source was detected. The no action sites generally consist of rubble piles generated from construction excavation activities at ANL-W. Twenty-four sites were eliminated in this step.

Six sites for which detected concentrations of all contaminants at a site were not likely to pose a threat to human health were eliminated in Step 4. This low risk determination is based on the results of previous investigations and risk evaluations (e.g., Track 1 or Track 2 investigation). The type of investigation performed at each site is presented in Table 2-1. Five sites were eliminated in this step.

The last step, Step 5, of the site screening was to identify the sites that will be retained and further evaluated in the contaminant screening process. Therefore only the eight sites listed as "retained" in Table 2-2 will be further evaluated using the contaminant screening methodology discussed below.

2.5 Contaminant Screening Methodology

The contaminant screening method depicted in Figure 2-1 involved compiling all sampling data for each site retained in the site screening. The sources of sampling results used in the contaminant screening are various Track 1, Track 2 and other investigation reports. The steps to complete the contaminant screening are presented below:

1. Contaminant concentrations less than or equal to background concentrations were omitted from the risk evaluation. Background concentrations were obtained from Rood et al. (1995). Ninety-five/ninety-five upper tolerance limits for grab samples were used because no soil samples were composites. If background concentrations were not available for a given contaminant then the contaminant was retained.

2. Six inorganic constituents (i.e., aluminum, calcium, iron, magnesium, potassium and sodium) are eliminated from analysis in the baseline risk assessment, based on EPA guidance (EPA 1991). For those concentrations of these constituents that exceed background, a footnote will be added explaining why it is believed that these constituents are not from contamination at the site.

Tables 2-3 through 2-11 summarizes the maximum concentration of each contaminant found at each site, the background concentrations of contaminants, the frequency of detection and whether or not the contaminant was eliminated from the risk evaluation. If the contaminant was screened, the justification by step number stated in Section 2.1 is provided in the last column of each table. It should be noted that sludge samples are considered to be soil samples for this screening process. As discussed in the *Final Scope of Work for the Waste Area Group 9 Comprehensive Remedial Investigation/Feasibility Study at the Idaho National Engineering*

Laboratory (ANL-W, 1995h), there are no complete exposure pathways for human receptors and surface water. Therefore, screening of the contaminants in the surface water is not performed. However, the analytical results for the surface water will be used to determine if the contaminants detected in the surface water were analyzed for in the sludges and subsurface soil.

In addition, although surface water exists at the Industrial Waste Pond and the North Ditch, exposure to the water in a residential scenario is not evaluated because the surface water comes from the cooling water from the sodium processing facility at ANL-W and would not exist in a future residential scenario. Occupational exposure to surface water is controlled through the use of "no trespassing" signs on the INEL and signs around the Industrial Waste Pond.

The results of the site and contaminant screening process are summarized in Table 2-12. As shown in this table, 8 sites are retained to evaluate cumulative effects from the contaminants remaining at these sites. Table 2-12 also lists all the contaminants that will be analyzed at those retained sites, and whether or not data gaps exists at these sites. All eight sites will be included in the baseline risk assessment. While some sites that have been retained were approved by the RPMs for "no further action," they are retained because risks were greater than 1E-06 and may cause adverse effects to human health and the environment when combined to the sources present at other sites retained for analysis in OU 9-04.

2.6 Summary and Filling of Data Gaps

This section summarizes the data gaps identified in Table 2-12 by site. Data gaps were identified after review of the Track 1, Track 2 and other investigation documents (e.g., initial assessment) for each OU. If the available documentation indicated that (1) specific media were not evaluated in the previous investigation, (2) insufficient data existed to conduct a risk assessment, or (3) the risk was previously unevaluated, data gaps were identified for the WAG 9 Comprehensive RI/FS. Sites that require additional sampling to fill identified data gaps will be evaluated against the site and contaminant screening criteria during the RI/BRA.

2.6.1 OU 9-01: ANL Sewage Lagoons (ANL-04)

According to the Track 1 Decision Documentation Package, the loss of 1 million gallons of water from the sewage lagoons has not been evaluated ANL-W has evaluated the one million gallon loss of sanitary waste with an estimated three percent solids from the sanitary lagoon and has determined that a data gap does not exist. The sewage lagoon was just being put into service when the leak occurred and the water loss was only sanitary sewage. The leak also occurred before the discharge of photo processing solutions to the sanitary system began. The results of 1994 sampling of sludge also indicated that metal levels did not pose a risk to groundwater. The contaminants in the raw water released are not known. Therefore, the source term for model calculations is not known. Furthermore, the release was sanitary waste water so the presence of coliform bacteria in down gradient wells should indicate any impact to the aquifer. To date samples of the two ANL-W down gradient production wells have never detected coliform bacteria. In order to officially evaluate the EPA and IDHW RPM concern on the water loss, this site will be retained and a summary of the evaluation will be included in the RI report with the baseline risk assessment.

Table 2-2 Summary of potential release sites retained or eliminated from risk evaluation of WAG 9.

OU	Subunit	Site Description	Type of Investigation	Eliminate/retain	Reason for Elimination
None	ANL-10	Dry Well between T-1 and ZPPR Mound	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-11	Waste Retention Tank 783	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-12	Suspect Waste Retention Tank by 793	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-14	Septic Tank and Drain Fields (2) by 753	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-15	Dry Well by 768	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-16	Dry Well by 759 (2)	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-17	Dry Well by 720	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-18	Septic Tank and Drain Field by 789	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-20	Septic Tank and Drain Field by 793	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-21	TREAT Suspect Waste Tank and Leaching Field (Non-radioactive)	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-22	TREAT Septic Tank and Leaching Field	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-23	TREAT Seepage Pit and Septic Tank West of 720	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-24	Lab and Office Acid Neutralization Tank	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-25	Interior Building Coffin Neutralization Tank	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-26	Critical Systems Maintenance Degreasing Unit	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-27	Plant Services Degreasing Unit	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-32	TREAT Control Building 721 Septic Tank and Leach Field (present)	Environmental characterization	Eliminate	Screening methodology Step 3: no source.
None	ANL-33	TREAT Control Building 721 Septic Tank and Seepage Pit	Environmental characterization	Eliminate	Screening methodology Step 3: no source.

Table 2-2 (continued).

OU	Subunit	Site Description	Type of Investigation	Eliminate/retain	Reason for Elimination
9-01	ANL-04	ANL Sewage Lagoons	Track 1	Retain	
9-01	ANL-19	Sludge Pit West of T-7 (Imhoff Tank)	Track 1	Eliminate	Screening methodology Step 3:no source.
9-01	ANL-28	EBR-II Sump	Track 1	Eliminate	Screening methodology Step 3: no source.
9-01	ANL-29	Industrial Waste Lift Station	Track 1	Eliminate	Screening methodology Step 4: Eliminate per Track 1 findings risk <1E-06.
9-01	ANL-30	Sanitary Waste Lift Station	Track 1	Eliminate	Screening methodology Step 4: Eliminate per Track 1 findings risk <1E-06.
9-01	ANL-36	TREAT Photo Processing Discharge Ditch	Track 1	Eliminate	Screening methodology Step 4: Eliminate per Track 1 findings risk <1E-06.
9-01	ANL-60	Knawa Butte Debris Pile	Track 1	Eliminate	Screening methodology Step 3: no source.
9-01	ANL-61	EBR-II Transformer Yard	Track 1	Eliminate	Screening methodology Step 4: Eliminate per Track 1 findings risk <1E-06.
9-01	ANL-61A	PCB-contaminated soil adjacent to ANL-61	No previous investigation	Retain	
9-01	ANL-62	Sodium Boiler Building (766) Hotwell	Track 1	Eliminate	Screening methodology Step 3: no source
9-01	ANL-63	Septic Tank 789-A	Track 1	Eliminate	Screening methodology Step 3: no source
9-02	ANL-08	EBR-II Leach Pit (Radioactive)	Track 2	Retain	
9-03	ANL-05	ANL Open Burn Pits #1, #2, and #3	Track 2	Eliminate	Screening methodology step 4: eliminate per Track 2 finding risk < 1E-06
9-03	ANL-31	Industrial/Sanitary Waste Lift Station (Industrial Side Not Used)	Track 2	Eliminate	Screening methodology step 3: no source.
9-03	ANL-34	Fuel Oil Spill by Building 755	Track 2	Eliminate	Screening methodology Step 4: Eliminate because Track 2 findings risk <1E-06.
9-04	ANL-01	Industrial Waste Pond and Cooling Tower Blowdown Ditches (3)	RI/FS	Retain	
9-04	ANL-01A	Main Cooling Tower Blowdown Ditch	RI/FS	Retain	
9-04	ANL-09	ANL Interceptor Canal	RI/FS	Retain	

Table 2-2 (continued).

OU	Subunit	Site Description	Type of Investigation	Eliminate/retain	Reason for Elimination
9-04	ANL-35	Industrial Waste Lift Station Discharge Ditch	RI/FS	Retain	
9-04	ANL-53	Cooling Tower Riser Pits	RI/FS	Retain	

Table 2-3 Contaminant screening process for OU 9-01, ANL-04, Sewage Lagoons.

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Aluminum	12,100	24,000	0/7 (0%)	7/7 (100%)	Y	1
Antimony	ND[d]	7.4	0/7 (0%)	0/7 (0%)	Y	1
Arsenic	10.4	7.4	2/7 (29%)	6/7 (86%)	N	NA
Barium	559	440	1/7 (14%)	7/7 (100%)	N	NA
Beryllium	1.8	3.0	0/7 (0%)	7/7 (100%)	Y	1
Cadmium	ND	3.7	0/7 (0%)	0/7 (0%)	Y	1
Calcium	77,100	39,000	1/7 (14%)	7/7 (100%)	Y[f]	3
Chromium	76.4	50	2/7 (29%)	6/7 (86%)	N	NA
Cobalt	8.6	18	0/7 (0%)	1/7 (14%)	Y	1
Copper	346	32	3/7 (43%)	6/7 (86%)	N	NA
Cyanide	ND	—[e]	0/7 (0%)	0/7 (0%)	Y	1
Iron	14,700	35,000	0/7 (0%)	7/7 (100%)	Y	1
Lead	121	23	4/7 (57%)	7/7 (100%)	N	NA
Magnesium	14,800	19,000	0/7 (0%)	7/7 (100%)	Y	1
Manganese	254	700	0/7 (0%)	7/7 (100%)	Y	1
Mercury	3.2	0.074	3/7 (43%)	3/7 (43%)	N	NA
Nickel	41.4	55	0/7 (0%)	5/7 (71%)	Y	1
Potassium	3,150	6,300	0/7 (0%)	7/7 (100%)	Y	3
Selenium	3.5	0.34	3/7 (43%)	3/7 (43%)	N	NA

Table 2-3 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Silver	37.2	—	1/7 (14%)	1/7 (14%)	N	NA
Sodium	1,530	520	5/7 (71%)	7/7 (100%)	Y[f]	3
Thallium	ND	0.68	0/7 (0%)	0/7 (0%)	Y	1
Vanadium	72.6	70	1/7 (14%)	6/7 (86%)	N	NA
Zinc	2,390	220	3/7 (43%)	7/7 (100%)	N	NA
Ag-108m	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Ag-110m	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Am-241	ND	0.019	0/8 (0%)	0/8 (0%)	Y	1
Ce-144	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Cm-242	ND	—	0/2 (0%)	0/2 (0%)	Y	1
Cm-244	ND	—	0/2 (0%)	0/2 (0%)	Y	1
Co-60	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Cs-134	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Cs-137	0.32	1.28	0/8 (0%)	4/8 (50%)	Y	1
Eu-152	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Eu-154	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Mn-54	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Pu-238	ND	0.0091	0/2 (0%)	0/2 (0%)	Y	1
Pu-239/240	ND	0.19	0/2 (0%)	0/2 (0%)	Y	1

Table 2-3 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Ru-106	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Sb-125	ND	—	0/8 (0%)	0/8 (0%)	Y	1
Sr-90	4.2	0.76	1/2 (50%)	1/2 (50%)	N	NA
Th-228	ND	2.1	0/2 (0%)	0/2 (0%)	Y	1
Th-230	ND	1.88	0/2 (0%)	0/2 (0%)	Y	1
Th-232	ND	2.1	0/2 (0%)	0/2 (0%)	Y	1
U-232	ND	—	0/2 (0%)	0/2 (0%)	Y	1
U-235	ND	—	0/8 (0%)	0/8 (0%)	Y	1
U-238	ND	1.85	0/2 (0%)	0/2 (0%)	Y	1
Zn-65	ND	—	0/8 (0%)	0/8 (0%)	Y	1

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Not detected. All contaminants with a "U" or "R" data qualifier flag are omitted.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-4 Contaminant screening process for OU 9-01, ANL-61A, PCB-contaminated soil adjacent to ANL-61.

	Step 1		Step 2			
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration (mg/kg or pCi/g)	Frequency of exceedance[a]	Frequency of detection[b]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
PCBs	55	—[c]	2/6 (33%)	2/6 (33%)	N	NA

a. Expressed as number of detections above background/total number of samples analyzed and as a percent.

b. Expressed as number of detections/total numbers of samples analyzed and as a percent.

c. No background concentration is available. Therefore, any detection is considered to exceed background.

Table 2-5 Contaminant screening process for OU 9-02, ANL-08, EBR-II Leach Pit.

	Step 1		Step 2			
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
1,1,1-Trichloroethane[d]	0.004	—[e]	1/1 (100%)	1/1 (100%)	N	NA
Acetone	1.1	—	2/6 (33%)	2/6 (33%)	N	NA
Aluminum	15,036.72	24,000	0/7 (0)%	7/7 (100%)	Y	1
Anthracene	0.11	—	1/6 (17%)	1/6 (17%)	N	NA
Antimony	37.09	7.4	7/7 (100%)	7/7 (100%)	N	NA
Aroclor-1254	6.1	—	3/6 (50%)	3/6 (50%)	N	NA
Aroclor-1260	1.8	—	3/6 (50%)	3/6 (50%)	N	NA
Arsenic	52.8	7.4	4/7 (57%)	7/7 (100%)	N	NA
Barium	255.2	440	0/7 (0%)	7/7 (100%)	Y	1
Benzo(a)anthracene	0.48	—	1/6 (17%)	1/6 (17%)	N	NA
Benzo(k)fluoranthene	0.45	—	1/6 (17%)	1/6 (17%)	N	NA
Beryllium	770.05	3.0	2/7 (29%)	7/7 (100%)	N	NA
Bis(2-ethylhexyl)phthalate	5.3	—	1/1 (100%)	1/1 (100%)	N	NA
Butylbenzlphthalate	0.051	—	1/6 (17%)	1/6 (17%)	N	NA
Cadmium	49.78	3.7	7/7 (100%)	7/7 (100%)	N	NA
Calcium	194,075.47	39,000	3/7 (43%)	7/7 (100%)	Y[g]	3
Chromium	4,305.33	50	4/7 (57%)	7/7 (100%)	N	NA
Chrysene	0.63	—	1/6 (17%)	1/6 (17%)	N	NA
Cobalt	12.55	18	0/7(0%)	7/7 (100%)	Y	1

Table 2-5 (continued).

Contaminant	Step 1: Maximum detected concentration (mg/kg or pCi/g)	Step 1: Background screening concentration[a] (mg/kg or pCi/g)	Step 2: Frequency of exceedance[b]	Step 2: Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Copper	18,839.4	32	4/7 (57%)	7/7 (100%)	N	NA
Cyanide	34.32	—	7/7 (100%)	7/7 (100%)	N	NA
di-n-butylphthalate	2	—	2/6 (33%)	2/6 (33%)	N	NA
Fluoranthene	0.170	—	1/5 (20%)	1/5 (20%)	N	NA
HpCDD	1.04E-04	—	3/6 (50%)	3/6 (50%)	N	NA
HpCDF	1.52E-05	—	3/6 (50%)	3/6 (50%)	N	NA
HxCDD	7.64E-05	—	3/6 (50%)	3/6 (50%)	N	NA
HxCDF	1.50E-05	—	3/6 (50%)	3/6 (50%)	N	NA
Iron	32,243.72	35,000	0/7 (0%)	7/7 (100%)	Y	1
Lead	287.98	23	4/7 (57%)	7/7 (100%)	N	NA
Magnesium	15,124.14	19,000	0/7 (0%)	7/7 (100%)	Y	1
Manganese	352.61	700	0/7 (0%)	7/7 (100%)	Y	1
Mercury	496.6	0.074	5/6 (83%)	5/6 (83%)	N	NA
Methylene chloride	ND	—	0/5 (0%)	0/5 (0%)	Y	1
Naphthalene	0.089	—	1/1 (100%)	1/1 (100%)	N	NA
Nickel	75.24	55	1/7 (14%)	7/7 (100%)	N	NA
OCDD	4.19E-04	—	5/6 (83%)	5/6 (83%)	N	NA
OCDF	7.20E-06	—	3/6 (50%)	3/6 (50%)	N	NA

Table 2-5 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
PeCDD	5.60E-06	—	1/6 (17%)	1/6 (17%)	N	NA
PeCDF	2.60E-06	—	3/6 (50%)	3/6 (50%)	N	NA
Phenanthrene	0.340	—	1/6 (17%)	1/6 (17%)	N	NA
Potassium	2,298.52	6,300	0/6 (0%)	6/6 (100%)	Y	1
Pyrene	0.670	—	1/6 (17%)	1/6 (17%)	N	NA
Selenium	0.15	0.34	0/7 (0%)	1/7 (14%)	Y	1
Silver	22.63	—	5/7 (71%)	5/7 (71%)	N	NA
Sodium	1,047.99	520	3/7 (43%)	7/7 (100%)	Y[g]	3
Sulfate	82.2	—	5/6 (83%)	5/6 (83%)	N	NA
TCDD	2.20E-07	—	1/6 (17%)	1/6 (17%)	N	NA
TCDF	6.50E-07	—	2/6 (33%)	2/6 (33%)	N	NA
Thallium	22.4	0.68	7/7 (100%)	7/7 (100%)	N	NA
Vanadium	50.9	70	0/7 (0%)	7/7 (100%)	Y	1
Zinc	3,016.8	220	4/7 (57%)	7/7 (100%)	N	NA
Am-241	0.65	0.019	3/7 (43%)	3/7 (43%)	N	NA
Ce-144	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Co-58	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Co-60	209	—	4/6 (67%)	4/6 (67%)	N	NA

Table 2-5 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Cs-134	1.8	—	2/7 (29%)	2/7 (29%)	N	NA
Cs-137	29,110	1.28	5/7 (71%)	6/7 (86%)	N	NA
I-129	124	—	1/7 (14%)	1/7 (14%)	N	NA
Np-237	329	—	6/7 (86%)	6/7 (86%)	N	NA
Pu-238	0.44	0.0091	2/7 (29%)	2/7 (29%)	N	NA
Pu-239/240	3.55	0.19	2/7 (29%)	2/7 (29%)	N	NA
Ru-103	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Ru-106	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Sb-125	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Sr-90	2,247	0.76	4/7 (57%)	6/7 (86%)	N	NA
U-234	35.64	1.95	4/7 (57%)	7/7 (100%)	N	NA
U-235	2.18	—	4/7 (57%)	4/7 (57%)	N	NA

Table 2-5 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
U-238	3.54	1.85	2/7 (29%)	7/7 (100%)	N	NA

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Only those organic compounds detected are presented. A complete listing of all the analytical results is presented in Appendix A.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

g. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-6 Contaminant screening process for OU 9-04, ANL-01, Industrial Waste Pond.

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
1,1,1-Trichlorethane[d]	0.021	—[e]	4/7 (57%)	4/7 (57%)	N	NA
2,4,5-TP (Silvex)	27.6	—	1/1 (100%)	1/1 (100%)	N	NA
2-Butanone	0.200	—	6/7 (86%)	6/7 (86%)	N	NA
Acetone	0.130	—	5/6 (83%)	5/6 (83%)	N	NA
Aluminum	31,800	24,000	1/19 (5%)	19/19 (100%)	Y[g]	3
Antimony	7.66	7.4	1/10 (10%)	1/10 (10%)	N	NA
Arsenic	25	7.4	10/19 (53%)	13/19 (68%)	N	NA
Barium	406	440	0/23 (0%)	19/23 (83%)	Y	1
Beryllium	2.2	3.0	0/19 (0%)	17/19 (89%)	Y	1
Cadmium	7	3.7	4/23 (17%)	19/23 (83%)	N	NA
Calcium	139,000	39,000	13/19 (68%)	14/19 (74%)	Y[g]	3
Chloride	44	—	6/6 (100%)	6/6 (100%)	N	NA
Chloroform	0.005	—	2/7 (29%)	2/7 (29%)	N	NA
Chromium	11,400	50	14/23 (61%)	23/23 (100%)	N	NA
Cobalt	17.9	18	0/19 (0%)	19/19 (100%)	Y	1
Copper	137	32	9/19 (47%)	19/19 (100%)	N	NA
Cyanide	ND[f]	—	0/4 (0%)	0/4 (0%)	Y	1
Fluoride	9.1	—	6/6 (100%)	6/6 (100%)	N	NA
Iron	42,800	35,000	1/19 (5%)	19/19 (100%)	Y[g]	3

Table 2-6 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Lead	32.6	23	4/23 (17%)	19/23 (83%)	N	NA
Magnesium	74,700	19,000	2/19 (11%)	19/19 (100%)	Y[g]	3
Manganese	746	700	1/19 (5%)	19/19 (100%)	N	NA
Mercury	6.8	0.074	8/19 (42%)	9/19 (47%)	N	NA
Methylene chloride	0.300	—	6/6 (100%)	6/6 (100%)	N	NA
Nickel	65.2	55	2/19 (11%)	19/19 (100%)	N	NA
Nitrate	3.1	—	4/4 (100%)	4/4 (100%)	N	NA
Phosphate	1.3	—	4/4 (100%)	4/4 (100%)	N	NA
Potassium	8,110	6,300	2/19 (11%)	19/19 (100%)	Y[g]	3
Selenium	3.3	0.34	3/19 (16%)	3/19 (16%)	N	NA
Silver	37.9	—	12/23 (52%)	12/23 (52%)	N	NA
Sodium	1,310	520	9/19 (47%)	18/19 (95%)	Y[g]	3
Sulfate	3,300	—	7/8 (88%)	7/8 (88%)	N	NA
Thallium	ND	0.68	0/13 (0%)	0/13 (0%)	Y	1
Toluene	0.005	—	2/7 (29%)	2/7 (29%)	N	NA
Vanadium	109	70	2/19 (11%)	19/19 (100%)	N	NA
Zinc	5,850	220	9/19 (47%)	19/19 (100%)	N	NA
Ag-108m	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Ag-110m	ND	—	0/11 (0%)	0/11 (0%)	Y	1

Table 2-6 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Am-241	ND	0.019	0/11 (0%)	0/11 (0%)	Y	1
Ce-144	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Cm-242	ND	—	0/4 (0%)	0/4 (0%)	Y	1
Cm-244	0.11	—	1/4 (25%)	1/4 (25%)	N	NA
Co-60	0.22	—	8/13 (62%)	8/13 (62%)	N	NA
Cs-134	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Cs-137	29.2	1.28	10/23 (43%)	22/23 (96%)	N	NA
Eu-152	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Eu-154	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Mn-54	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Pu-238	0.003	0.0091	0/8 (0%)	1/8 (13%)	Y	1
Pu-239/240	0.232	0.19	1/16 (6%)	7/16 (44%)	N	NA
Ra-226	1.21	—	3/3 (100%)	3/3 (100%)	N	NA
Ru-106	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Sb-125	ND	—	0/11 (0%)	0/11 (0%)	Y	1
Sr-90	2.5	0.76	1/4 (25%)	1/4 (25%)	N	NA
Th-228	0.19	2.1	0/5 (0%)	1/5 (20%)	Y	1
Th-230	1.7	1.88	0/5 (0%)	4/5 (80%)	Y	1
Th-232	1.39	2.1	0/9 (0%)	5/9 (56%)	Y	1

Table 2-6 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
U-232	ND	—	0/4 (0%)	0/4 (0%)	Y	1
U-235	ND	—	0/11 (0%)	0/11 (0%)	Y	1
U-238	2.9	1.85	1/4 (25%)	3/4 (75%)	N	NA
Zn-65	ND	—	0/11 (0%)	0/11 (0%)	Y	1

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Only those organic compounds detected are presented. A complete listing of all the analytical results is presented in Appendix A.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

g. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-7 Contaminant screening process for OU 9-04, ANL-01, Industrial Waste Pond, Ditches A, B, and C.

	Step 1		Step 2			
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
1,1,1-Trichloroethane[d]	0.530	—[e]	7/13 (54%)	7/13 (54%)	N	NA
2-Butanone	0.180	—	6/13 (46%)	6/13 (46%)	N	NA
Acetone	0.079	—	6/12 (50%)	6/12 (50%)	N	NA
Aluminum	19,200	24,000	0/54 (0%)	54/54 (100%)	Y	1
Antimony	ND[f]	7.4	0/54 (0%)	0/54 (0%)	Y	1
Arsenic	18.1	7.4	22/82 (27%)	73/82 (89%)	N	NA
Barium	1,690	440	1/82 (1%)	82/82 (100%)	N	NA
Beryllium	3.9	3.0	1/54 (2%)	53/54 (98%)	N	NA
Bis(2-ethylhexyl)phthalate	0.120	—	1/1 (100%)	1/1 (100%)	N	NA
Cadmium	4	3.7	1/82 (1%)	38/82 (46%)	N	NA
Calcium	190,000	39,000	33/54 (61%)	54/54 (100%)	Y[g]	3
Chloride	37	—	3/3 (100%)	3/3 (100%)	N	NA
Chloroform	0.004	—	2/13 (15%)	2/13 (15%)	N	NA
Chromium	6,210	50	29/82 (35%)	82/82 (100%)	N	NA
Cobalt	14.8	18	0/53 (0%)	53/53 (100%)	Y	1
Copper	216	32	26/54 (48%)	54/54 (100%)	N	NA
Cyanide	12.2	—	8/45 (18%)	8/45 (18%)	N	NA
Fluoride	7	—	3/3 (100%)	3/3 (100%)	N	NA
Iron	22,900	35,000	0/54 (0%)	54/54 (100%)	Y	1

Table 2-7 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Lead	91.2	23	21/82 (26%)	82/82 (100%)	N	NA
Magnesium	19,800	19,000	1/53 (2%)	53/53 (100%)	Y[g]	3
Manganese	705	700	1/53 (2%)	53/53 (100%)	N	NA
Mercury	4.1	0.074	32/82 (39%)	40/82 (49%)	N	NA
Methylene chloride	0.210	—	6/9 (67%)	6/9 (67%)	N	NA
Nickel	91.6	55	2/54 (4%)	54/54 (100%)	N	NA
Nitrate	9.5	—	3/3 (100%)	3/3 (100%)	N	NA
Phosphate	17	—	3/3 (100%)	3/3 (100%)	N	NA
Potassium	5,130	6,300	0/54 (0%)	54/54 (100%)	Y	1
Selenium	0.61	0.34	5/82 (6%)	5/82 (6%)	N	NA
Silver	14.2	—	16/82 (20%)	16/82 (20%)	N	NA
Sodium	1,030	520	15/54 (28%)	54/54 (100%)	Y[g]	3
Sulfate	620	—	3/3 (100%)	3/3 (100%)	N	NA
Thallium	1.6	0.68	2/45 (4%)	2/45 (4%)	N	NA
Toluene	0.004	—	4/13 (31%)	4/13 (31%)	N	NA
Vanadium	68.8	70	0/54 (0%)	54/54 (100%)	Y	1
Zinc	3,020	220	23/54 (43%)	54/54 (100%)	N	NA
Ag-108m	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Ag-110m	ND	—	0/65 (0%)	0/65 (0%)	Y	1

Table 2-7 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Am-241	ND	0.019	0/65 (0%)	0/65 (0%)	Y	1
Ce-144	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Cm-242	ND	—	0/6 (0%)	0/6 (0%)	Y	1
Cm-244	ND	—	0/6 (0%)	0/6 (0%)	Y	1
Co-60	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Cs-134	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Cs-137	0.85	1.28	0/65 (0%)	32/65 (49%)	Y	1
Eu-152	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Eu-154	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Mn-54	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Pu-238	ND	0.0091	0/6 (0%)	0/6 (0%)	Y	1
Pu-239/240	0.11	0.19	0/6 (0%)	1/6 (17%)	Y	1
Ru-106	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Sb-125	ND	—	0/65 (0%)	0/65 (0%)	Y	1
Sr-90	4.5	0.76	1/16 (17%)	1/16 (17%)	N	NA
Th-228	ND	2.1	0/6 (0%)	0/6 (0%0	Y	1
Th-230	1.8	1.88	0/6 (0%)	2/6 (33%)	Y	1
Th-232	ND	2.1	0/6 (0%)	0/6 (0%)	Y	1
U-232	ND	—	0/6 (0%)	0/6 (0%)	Y	1

Table 2-7 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
U-235	ND	—	0/65 (0%)	0/65 (0%)	Y	1
U-238	21	1.85	3/6 (50%)	3/6 (50%)	N	NA
Zn-65	ND	—	0/65 (0%)	0/65 (0%)	Y	1

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Only those compounds detected are presented. A complete listing of all the analytical results is presented in Appendix A.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

g. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-8 Contaminant screening process for OU 9-04, ANL-01A, Main Cooling Tower Blowdown Ditch.

	Step 1			Step 2		
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
2,4-D	0.0064	—	1/2 (50%)	1/2 (50%)	N	NA
Aluminum	16,800	24,000	0/47 (0%)	45/47 (96%)	Y	1
Antimony	61.5	7.4	14/37 (38%)	15/37 (41%)	N	NA
Arsenic	74.6	7.4	21/54 (39%)	53/54 (98%)	N	NA
Barium	1,030	440	1/54 (2%)	53/54 (98%)	N	NA
Beryllium	4.2	3.0	1/47 (2%)	36/47 (77%)	N	NA
Bis(2-ethylhexyl)phthalate	0.096	—	1/1 (100%)	1/1 (100%)	N	NA
Cadmium	3.3	3.7	0/54 (0%)	18/54 (33%)	Y[g]	1
Calcium	91,200	39,000	28/47 (60%)	46/47 (98%)	Y	3
Chromium	2,200	50	21/54 (39%)	54/54 (100%)	N	NA
Cobalt	25.7	18	1/44 (2%)	24/44 (55%)	N	NA
Copper	999	32	18/47 (38%)	47/47 (100%)	N	NA
Cyanide	12.6	—	8/47 (17%)	8/47 (17%)	N	NA
di-n-octylphthalate	0.048	—	1/2 (50%)	1/2 (50%)	N	NA
Iron	46,400	35,000	2/47 (4%)	47/47 (100%)	Y[g]	3
Lead	159	23	18/54 (33%)	54/54 (100%)	N	NA
Magnesium	15,400	19,000	0/44 (0%)	44/44 (100%)	Y	1
Manganese	1,180	700	5/44 (11%)	44/44 (100%)	N	NA
Mercury	16.1	0.074	26/54 (48%)	26/54 (48%)	N	NA

Table 2-8 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Nickel	540	55	5/47 (11%)	47/47 (100%)	N	NA
Potassium	4,730	6,300	0/47 (0%)	46/47 (98%)	Y	1
Selenium	2.2	0.34	4/54 (7%)	4/54 (7%)	N	NA
Silver	94.7	—	17/52 (33%)	17/52 (33%)	N	NA
Sodium	3,060	520	12/47 (26%)	39/47 (83%)	Y[g]	3
Sulfate	ND[f]	—	0/1 (0%)	0/1 (0%)	Y	1
Thallium	ND	0.68	0/47 (0%)	0/47 (0%)	Y	1
Vanadium	74.1	70	1/47 (2%)	47/47 (100%)	N	NA
Zinc	2,130	220	11/47 (23%)	44/47 (94%)	N	NA
Ag-108m	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Ag-110m	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Am-241	ND	0.019	0/43 (0%)	0/43 (0%)	Y	1
Ce-144	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Cm-242	ND	—	0/2 (0%)	0/2 (0%)	Y	1
Cm-244	ND	—	0/2 (0%)	0/2 (0%)	Y	1
Co-60	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Cs-134	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Cs-137	0.23	1.28	0/43 (0%)	12/43 (28%)	Y	1

Table 2-8 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Eu-152	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Eu-154	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Mn-54	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Pu-238	ND	0.0091	0/2 (0%)	0/2 (0%)	Y	1
Pu-239/240	ND	0.19	0/2 (0%)	0/2 (0%)	Y	1
Ru-106	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Sb-125	ND	—	0/43 (0%)	0/43 (0%)	Y	1
Sr-90	ND	0.76	0/2 (0%)	0/2 (0%)	Y	1
Th-228	ND	2.1	0/2 (0%)	0/2 (0%)	Y	1
Th-230	ND	1.88	0/2 (0%)	0/2 (0%)	Y	1
Th-232	ND	2.1	0/2 (0%)	0/2 (0%)	Y	1
U-232	ND	—	0/2 (0%)	0/2 (0%)	Y	1
U-235	ND	—	0/43 (0%)	0/43 (0%)	Y	1
U-238	2.7	1.85	1/2 (50%)	1/2 (50%)	N	NA
Zn-65	ND	—	0/43 (0%)	0/43 (0%)	Y	1

Table 2-8 (continued).

Contaminant	Step 1: Maximum detected concentration (mg/kg or pCi/g)	Step 1: Background screening concentration[a] (mg/kg or pCi/g)	Step 2: Frequency of exceedance[b]	Step 2: Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Only those organic compounds detected are presented. A complete listing of all the analytical results is presented in Appendix A.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

g. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-9 Contaminant screening process for OU 9-04, ANL-09, ANL Interceptor Canal.

	Step 1			Step 2		
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Aluminum	19,700	24,000	0/17 (0%)	17/17 (100%)	Y	1
Antimony	ND[d]	7.4	0/17 (0%)	0/17 (0%)	Y	1
Arsenic	11.9	7.4	12/17 (71%)	14/17 (82%)	N	NA
Barium	341	440	0/17 (0%)	17/17 (100%)	Y	1
Beryllium	1.3	3.0	0/17 (0%)	17/17 (100%)	Y	1
Cadmium	1.6	3.7	0/17 (0%)	7/17 (41%)	Y	1
Calcium	71,200	39,000	17/17 (100%)	17/17 (100%)	Y[f]	3
Chromium	30.2	50	0/17 (0%)	17/17 (100%)	Y	1
Cobalt	14.7	18	0/17 (0%)	17/17 (100%)	Y	1
Copper	34.8	32	1/17 (6%)	17/17 (100%)	N	NA
Cyanide	ND	—[e]	0/17 (0%)	0/17 (0%)	Y	1
Iron	25,500	35,000	0/17 (0%)	17/17 (100%)	Y	1
Lead	39.7	23	2/17 (12%)	17/17 (100%)	N	NA
Magnesium	17,300	19,000	0/17 (0%)	17/17 (100%)	Y	1
Manganese	632	700	0/17 (0%)	17/17 (100%)	Y	1
Mercury	0.33	0.074	6/17 (35%)	6/17 (35%)	N	NA
Nickel	35.6	55	0/17 (0%)	17/17 (100%)	Y	1
Potassium	5,680	6,300	0/17 (0%)	17/17 (100%)	Y	1
Selenium	ND	0.34	0/17 (0%)	0/17 (0%)	Y	1

Table 2-9 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Silver	1.6	—	1/17 (6%)	1/17 (6%)	N	NA
Sodium	363	520	0/17 (0%)	16/17 (94%)	Y	1
Thallium	ND	0.68	0/17 (0%)	0/17 (0%)	Y	1
Vanadium	53.9	70	0/17 (0%)	17/17 (100%)	Y	1
Zinc	145	220	0/17 (0%)	15/17 (88%)	Y	1
Ag-108m	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Ag-110m	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Am-241	0.13	0.019	2/109 (2%)	2/109 (2%)	N	NA
Ce-144	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Cm-242	ND	—	0/10 (0%)	0/10 (0%)	Y	1
Cm-244	0.06	—	1/10 (10%)	1/10 (10%)	Y	1
Co-60	0.37	—	23/109 (21%)	23/109 (21%)	N	NA
Cs-134	0.05	—	1/109 (1%)	1/109 (1%)	N	NA
Cs-137	52	1.28	48/109 (44%)	81/109 (74%)	N	NA
Eu-152	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Eu-154	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Mn-54	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Pu-238	ND	0.0091	0/10 (0%)	0/10 (0%)	Y	1
Pu-239/240	ND	0.19	0/10 (0%)	0/10 (0%)	Y	1

Table 2-9 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Ru-106	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Sb-125	ND	—	0/109 (0%)	0/109 (0%)	Y	1
Sr-90	5.8	0.76	3/10 (30%)	3/10 (30%)	N	NA
Th-228	ND	2.1	0/10 (0%)	0/10 (0%)	Y	1
Th-230	1.8	1.88	0/10 (0%)	5/10 (50%)	Y	1
Th-232	ND	2.1	0/10 (0%)	0/10 (0%)	Y	1
U-232	ND	—	0/10 (0%)	0/10 (0%)	Y	1
U-235	ND	—	0/109 (0%)	0/109 (0%)	Y	1
U-238	2.3	1.85	1/10 (10%)	6/10 (60%)	N	NA
Zn-65	ND	—	0/109 (0%)	0/109 (0%)	Y	1

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-10 Contaminant screening process for OU 9-04, ANL-35, Industrial Waste Lift Station Discharge Ditch.

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
1,1,1-Trichloroethane	0.004	—[e]	2/2 (100%)	2/2 (100%)	N	NA
Acetonitrile	0.0776	—	1/2 (50%)	1/2 (50%)	N	NA
Aluminum	29,800	24,000	1/24 (4%)	24/24 (100%)	Y[g]	3
Antimony	ND[f]	7.4	0/15 (0%)	0/15 (0%)	Y	1
Arsenic	12.1	7.4	7/36 (19%)	35/36 (97%)	N	NA
Barium	647	440	1/39 (3%)	38/39 (97%)	N	NA
Beryllium	5.8	3.0	2/24 (8%)	19/24 (79%)	N	NA
Butylbenzylphthalate	74	—	1/2 (50%)	1/2 (50%)	N	NA
Cadmium	4.8	3.7	4/39 (10%)	27/39 (69%)	N	NA
Calcium	102,000	39,000	9/24 (38%)	24/24 (100%)	Y[g]	3
Chloride	14	—	3/3 (100%)	3/3 (100%)	N	NA
Chromium	124	50	10/39 (26%)	39/39 (100%)	N	NA
Cobalt	27	18	1/22 (5%)	21/22 (95%)	N	NA
Copper	479	32	16/24 (67%)	24/24 (100%)	N	NA
Cyanide	14.3	—	6/20 (30%)	6/20 (30%)	N	NA
Di-n-octylphthalate	51	—	1/2 (50%)	1/2 (50%)	N	NA
Fluoride	4.8	—	3/3 (100%)	3/3 (100%)	N	NA
HpCDD	4.04E-06	—	2/2 (100%)	2/2 (100%)	N	NA
HpCDF	4.70E-07	—	½ (50%)	½ (50%)	N	NA

Table 2-10 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
HxCDF	2.90E-07	—	1/2 (50%)	1/2 (50%)	N	NA
Iron	50,600	35,000	1/24 (4%)	24/24 (100%)	Y[g]	3
Lead	47.2	23	8/39 (21%)	39/39 (100%)	N	NA
Magnesium	30,000	19,000	1/22 (5%)	22/22 (100%)	Y[g]	3
Manganese	1,200	700	2/22 (9%)	22/22 (100%)	N	NA
Mercury	1.3	0.074	21/39 (54%)	25/39 (64%)	N	NA
Nickel	64.4	55	1/24 (4%)	24/24 (100%)	N	NA
Nitrate	22	—	3/3 (100%)	3/3 (100%)	N	NA
OCDD	9.99E-06	—	2/2 (100%)	2/2 (100%)	N	NA
OCDF	5.80E-07	—	2/2 (100%)	2/2 (100%)	N	NA
PeCDD	2.20E-07	—	1/2 (50%)	1/2 (50%)	N	NA
Phosphate	2.5	—	3/3 (100%)	3/3 (100%)	N	NA
Potassium	7,390	6,300	1/24 (4%)	24/24 (100%)	Y[g]	3
Selenium	0.78	0.34	2/36 (6%)	2/36 (6%)	N	NA
Silver	352	—	34/39 (87%)	34/39 (87%)	N	NA
Sodium	936	520	13/24 (54%)	23/34 (96%)	Y[g]	3
Sulfate	140	—	3/5 (60%)	3/5 (60%)	N	NA
TCDF	4.70E-07	—	1/2 (50%)	1/2 (50%)	N	NA
Thallium	0.7	0.68	1/21 (5%)	1/21 (5%)	N	NA

Table 2-10 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Toluene	0.001	—	1/2 (50%)	1/2 (50%)	N	NA
Vanadium	71.6	70	1/24 (4%)	24/24 (100%)	N	NA
Zinc	491	220	6/24 (25%)	22/24 (92%)	N	NA
Ag-108m	ND	—	0/20 (0%)	0/20 (0%)	Y	1
Ag-110m	ND	—	0/20 (0%)	0/20 (0%)	Y	1
Am-241	ND	0.019	0/20 (0%)	0/20 (0%)	Y	1
Ce-144	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Cm-242	ND	—	0/2 (0%)	0/2 (0%)	Y	1
Cm-244	ND	—	0/2 (0%)	0/2 (0%)	Y	1
Co-60	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Cs-134	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Cs-137	2	1.28	2/19 (10%)	17/19 (89%)	N	NA
Eu-152	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Eu-154	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Mn-54	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Pu-238	ND	0.0091	0/2 (0%)	0/2 (0%)	Y	1
Pu-239/240	ND	0.19	0/2 (0%)	0/2 (0%)	Y	1
Ru-106	ND	—	0/19 (0%)	0/19 (0%)	Y	1
Sb-125	ND	—	0/19 (0%)	0/19 (0%)	Y	1

Table 2-10 (continued).

Contaminant	Step 1		Step 2		Contaminant eliminated? (Y/N)	Justification for elimination (step number)
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]		
Sr-90	ND	0.76	0/2 (0%)	0/2 (0%)	Y	1
Th-228	ND	2.1	0/2 (0%)	0/2 (0%)	Y	1
Th-230	ND	1.88	0/2 (0%)	0/2 (0%)	Y	1
Th-232	ND	2.1	0/2 (0%)	0/2 (0%)	Y	1
U-232	ND	—	0/2 (0%)	0/2 (0%)	Y	1
U-235	ND	—	0/19 (0%)	0/19 (0%)	Y	1
U-238	2.3	1.85	1/2 (50%)	2/2 (100%)	N	NA
Zn-65	ND	—	0/20 (0%)	0/20 (0%)	Y	1

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Only those organic compounds detected are presented. A complete listing of all the analytical results is presented in Appendix A.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

g. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

Table 2-11 Contaminant screening process for OU 9-04, ANL-53, Cooling Tower Riser Pits.

	Step 1		Step 2			
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Arsenic	76	7.4	8/16 (50%)	15/16 (94%)	N	NA
Chromium	1,727	50	9/16 (56%)	16/16 (100%)	N	NA
Hexavalent Chromium	ND[d]	—[e]	0/16 (0%)	0/16 (0%)	Y	1
Lead	4,725	23	8/16 (50%)	16/16 (100%)	N	NA
Mercury	0.78	0.074	8/16 (50%)	16/16 (100%)	N	NA

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

Table 2-12 Summary of WAG 9 Sites, COPCs, and potential data gaps.

OU	Site	Site description	COPCs	Contaminated Media	Potential data gaps
9-01	ANL-04	ANL Sewage Lagoons	As, Ba, Cr, Cu, Pb, Hg, Se, Ag, V, Zn, and Sr-90	Sludge	Yes
9-01	ANL-61A	PCB-contaminated soil adjacent to ANL-61	PCBs	Subsurface soil	Yes
9-02	ANL-08	EBR-II Leach Pit	1,1,1-TCA, acetone, anthracene, Sb, Aroclor-1254, Aroclor-1260, As, Be, benzo(a)anthracene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, Cd, Cr, Cu, chrysene, cyanide, di-n-butylphthalate, fluoranthene, HpCDD, HpCDF, HxCDD, HxCDF, Hg, naphthalene, Ni, OCDD, OCDF, Pb, PeCDD, PeCDF, phenanthrene, pyrene, Ag, sulfate, TCDD, TCDF, Tl, Zn, Am-241, Co-60, Cs-134, Cs-137, I-129, Np-237, Pu-238, Pu-239/240, Sr-90, U-234, U-235, and U-238	Subsurface soil	Yes
9-04	ANL-01	Industrial Waste Pond (Pond)	1,1,1,-TCA, 2,4,5-TP, 2-butanone, acetone, Sb, As, Cd, Chloride, chloroform, Cr, Cu, fluoride, Pb, Mn, Hg, methylene chloride, Ni, nitrate, phosphate, Se, Ag, sulfate, toluene, V, Zn, Cm-244, Co-60, Cs-137, Pu-239/240, Ra-226, Sr-90, and U-238	Subsurface soil, sludge, and surface water	Yes

Table 2-12 (continued).

OU	Site	Site description	COPCs	Contaminated Media	Potential data gaps
9-04	ANL-01	Industrial Waste Pond (Ditches)	1,1,1-TCA, 2-butanone, acetone, As, Ba, Be, bis(2-ethylhexyl)phthalate, Cd, chloride, chloroform, Cr, Cu, Cyanide, fluoride, Pb, Mn, Hg, methylene chloride, Ni, nitrate, phosphate, Se, Ag, sulfate, Tl, toluene, Zn, Sr-90, and U-238	Surface and subsurface soil	Yes
9-04	ANL-01A	Main Cooling Tower Blowdown Ditch	2,4-D, Sb, As, Ba, Be, bis(2-ethylhexyl)phthalate, Cr, Co, Cu, cyanide, di-n-octylphthalate, Pb, Mn, Hg, Ni, Se, Ag, V, Zn, and U-238	Surface and subsurface soil	Yes
9-04	ANL-09	ANL Interceptor Canal	As, Cu, Pb, Hg, Ag, Am-241, Cm-244, Co-60, Cs-134, Cs-137, Sr-90, and U-238	Surface and subsurface soil	No
9-04	ANL-35	Industrial Waste Lift Station Discharge Ditch	1,1,1-TCA, acetonitrile, As, Ba, Be, butylbenzylphthalate, Cd, chloride, Co, Cr, Cu, cyanide, di-n-octylphthalate, fluoride, HpCDD, HpCDF, HxCDF, Pb, Mn, Hg, Ni, OCDD, OCDF, Pb, PeCDD, phosphate, Se, Ag, sulfate, TCDF, Tl, toluene, V, Zn, Cs-137, and U-238	Surface and subsurface soil and surface water	No
9-04	ANL-53	Cooling Tower Riser Pits	As, Cr, Pb, and Hg	Subsurface soil	No

2.6.2 OU 9-01: PCB-Contaminated Soil Adjacent to ANL-61

Sampling conducted at this site indicates PCBs still remain in the soil at concentrations greater than the TSCA limit (i.e., 25 mg/kg). The surface soils are not anticipated to be contaminated based on the previous results directly below the transformers that show a lense of PCB contamination between bedrock and 4 feet. The occupational pathway is also eliminated by the decorative cobble rock placed over the native soil. However, no risk assessment was performed and the contaminated soil remains at the site. The removal of the contaminated soil and collection of verification soil samples will be completed when the tank is removed if the PCBs pose an unacceptable risk. Therefore, a data gap of performing a risk assessment for the remaining PCB-contaminated soil is identified and will be filled during the baseline risk assessment.

2.6.3 OU 9-02: EBR-II Leach Pit (ANL-08)

According to the *Preliminary Scoping Track 2 Summary Report for Operable Unit 9-02: EBR-II Leach Pit* (RUST Geotech, 1994g) three data gaps were identified. One data gap is that the groundwater flow in the vicinity of the leach pit has not been adequately assessed and is identified as a data gap along with the detection of dioxins in the groundwater. Evaluation of the groundwater flow direction assists in determining the location of and distance to the receptors as part of the risk assessment. In addition, determination if contaminant leaching to the groundwater is occurring, and if so, identifying those contaminants and evaluate the risk to human health from exposure to them. These data gaps will be filled during the baseline risk assessment by reviewing and validating the groundwater monitoring results, updating groundwater flow directions, groundwater equipotential lines, and sampling new groundwater monitoring wells.

The second data gap is to evaluate the effects to human health from the piping from the meter house to the Leach Pit. The piping will be removed prior to October 1, 1996 as a "housekeeping activity" and verification soil samples will be collected. Based on the analytical results of the verification soil samples, the potential effects to human health will be evaluated in the BRA. The third data gap is to re-evaluate the groundwater ingestion exposure pathway. Filling of all these groundwater data gaps is presented in Section 3 and also in Section 7 of this Work Plan.

2.6.4 OU 9-04: Industrial Waste Pond and Three Cooling Tower Blowdown Ditches (ANL-01)

Sampling was conducted at the IWP and three ditches in 1986, 1987, twice in 1988 and 1994. The revised preliminary scoping package evaluated the risk associated with the COPCs identified during the 1987 and 1988 sampling investigation. Radionuclides and metals were the analytes for the 1994 sampling. In addition, radionuclide soil data are available at the IWP for 1980 to 1992. Although a risk assessment was prepared for this site using the 1994 data, only the soil ingestion exposure pathway was evaluated. Therefore, an identified data gap for this site is to complete a risk evaluation using all the data and evaluating all exposure pathways in the baseline risk assessment.

2.6.5 OU 9-04: Main Cooling Tower Blowdown Ditch (ANL-01A)

Sampling was conducted at the MCTBD in 1987, twice in 1988 and 1994. The revised preliminary scoping package evaluated the risk associated with the COPCs identified during the 1987 and 1988 sampling investigation. Radionuclides and metals were the analytes for the 1994 sampling. Although a risk assessment was prepared for this site using the 1994 data, only the soil ingestion exposure pathway was evaluated. Therefore, an identified data gap for this site is to complete a risk evaluation using all the data and evaluating all exposure pathways in the baseline risk assessment.

3 HYDROLOGY

The hydrology at the ANL-W site has been separated into four distinct sections. These sections depict the actual conditions typically found at a site: surface water, groundwater, perched water, and vadose zone hydrology. These four hydrology sections are described in further detail below. The hydrologic investigation is a compilation of the data that has been collected up to 1993.

3.1 Surface Water

Recharge to the Snake River Plain Aquifer (SRPA) in the ANL-W area is limited to precipitation as snow or rain and seepage from ponds and ditches constructed to dispose of wastewater from facility operations. During rapid snow melt in the spring, moderate recharge to the aquifer can occur. However, high evapotranspiration rates during the summer and early fall prevents significant infiltration from rainfall during these periods.

No permanent, natural, surface water features exist near the ANL-W site. The existing surface water features (e.g., drainage ditches and discharge ponds) were constructed for ANL-W operations for the collection of intermittent surface runoff. A natural drainage channel has been altered to discharge to the IWP via the Interceptor Canal. Under the unusual conditions when the air temperature has been warm enough to cause snow-melt, but the ground has remained frozen, precluding infiltration, surface runoff along this channel has discharged to the IWP. This condition most recently occurred during the spring of 1995. During this time flow was visible from the surrounding basin into the IWP for approximately four days. However, at no time did any water discharge from the pond to the downstream channel. Before 1995, the most recent occurrence of this situation was in 1976.

Seepage from the Industrial Waste Pond and associated conveyance ditches probably yields some recharge to the SRPA. The discharge rate to the pond varies from 1.42 to 4.22 million gal/month (CH_2M Hill, 1978). From 1961 to 1970, approximately 24 million gal/yr were discharged to the Industrial Waste Pond. The maximum annual discharge rate was 31.7 million gal/yr, measured over the July 1977 to June 1978 period. From the period 1979 to 1994 discharges averaged 39 million gal/yr.

Discharge rates to the ANL-W Industrial Waste Pond are much lower than discharge rates at other facilities on the INEL (i.e., the ICPP and TRA). The ICPP discharges roughly 1.0 million to 2.0 million gal/day (approximately 370 million gal/yr) to their percolation ponds, while TRA discharged an average of approximately 180 million gal/yr, over the 1986 to 1991 period.

ANL-W believes this large disparity accounts for the lack of any defined perched water bodies at the facility.

3.2 Groundwater Hydrology

Estimates show nearly $2x10^9$ acre-feet of water exist in the SRPA with water usage within the boundaries of the INEL being approximately $5.6x10^3$ acre-feet per year. From 1979 to 1994, ANL-W withdrew an average of 138 million gallons of water per year from the SRPA. This water is extracted by two primary production wells, EBR-II #1 and EBR-II #2, as shown in Figure 3-1. These wells are operated on a rotating weekly basis to maintain equal pump wear. Production pumps have a capacity of approximately 1000 gpm. During normal operation the pumps are controlled by water level in the storage tanks. They are set for automatic start and shutoff, and run for about .75 to 1.5 hours a day. Under special conditions (eg. during pump tests) the pumps can be run manually. Principal uses of the water are for plant cooling water operations, boiler water and potable water.

Figure 3-2 and 3-3 at the end of this section presents the eguipotential map and general direction of groundwater movement underlying the INEL and ANL-W, respectively. They suggest that the regional flow in the SRPA is from northeast to southwest. Depth to the SRPA near the ANL-W facility is approximately 640 feet BLS, based on 1995 water level measurements. Transmissivities of the SRPA range from 29,000 to 556,000 feet squared per day, based on aquifer test data from two production wells at ANL-W (Martin et. al., 1993). The average gradient of the water table was estimated to be approximately 4 feet per mile. Assuming an effective aquifer thickness of 250 ft, a porosity of 10%, and the above-mentioned transmissivity range, the horizontal groundwater flow velocities may range from 0.9 to 17 ft/day.

From a groundwater modeling standpoint the clearly fracture controlled flow character of the aquifer appears to impose an insurmountable obstacle to effective modeling. However, discussions with the USGS (Orr, 1996) and numerous papers have suggested that the basalt aquifer can be represented as a porous media to scales as small as 100 feet by 100 feet before rock and fracture heterogeneities overwhelm the system. For the modeling reported later in this section, scales are on the order of thousands to tens of thousands of square feet.

3.2.1 Vadose Zone Hydrology

Perched water at ANL-W is discussed in section 1.3.5.3.1 above. The remainder of this section discusses known occurrences of water in the vadose zone at ANL-W. Vadose water, as used in this section, refers only to saturated conditions found above the regional water table.

Only three of the six boreholes drilled beside the Industrial Waste Pond encountered vadose water and only one of these boreholes yielded enough water for chemical sampling. The three boreholes that encountered vadose water are found next to the west side of the Industrial Waste Pond (boreholes ANL-M4, -M5 and -M6). The shallow vadose water is derived from Industrial Waste Pond seepage, based on analytical results of water quality samples from the pond and the vadose water from borehole ANL-M5 (Northern Engineering and Testing, Inc., 1988).

Water from the Industrial Waste Pond and this shallow water zone can be differentiated from water derived from the SRPA, in the ANL-W area. Pond water and shallow free vadose water is a mixed cationic (calcium-sodium sulphate) type, whereas ground water from the SRPA is characterized as a single cationic, calcium bicarbonate type (Chen-Northern, Inc., 1988). The similarity in cation percentages between the pond water and the vadose water samples suggests shallow ground water was derived from downward seepage of pond water.

The localized, non-extensive nature of this shallow vadose water is believed to be related to a couple of factors. First is the fact that discharge volumes to the Industrial Waste Pond are small compared with other facilities where extensive perched water zones have formed (e.g., TRA and ICPP). This smaller discharge means a smaller volume of water is moving down through the vadose zone. A smaller volume contacting a low permeability zone will take longer to show signs of perching than a larger volume. Secondly, the interbeds encountered are aerially non-extensive compared with other areas where perched water zones exist. Drilling around the IWP suggests that those interbeds present have a larger degree of "holes" than interbeds in other areas at the INEL. These holes allow for the direct migration of water through the vadose zone. Therefore, while some water may encounter a low permeability zone and be retarded, much of the flow passes through these "holes" unrestricted. Also, in relation to the first factor any saturation that may occur will not have far to move laterally before encountering a "hole" and continuing to move down through the section.

Other non-water producing zones of saturation exist deeper in the subsurface. A fine-grained sedimentary interbed exists about 400 ft BLS. Neutron logs suggest this 10-ft thick, aerially extensive unit may be saturated with water. A coarser grained sedimentary unit that occurs at a depth of approximately 504 ft BLS may also retain some water.

3.3 Groundwater and Vadose Zone Water Quality

This subsection outlines the present quality of groundwater beneath the ANL-W facility. This information is based on monthly, quarterly and annual water sampling analyses currently conducted at ANL-W. As any remediation and characterization activities are completed under the

comprehensive RI, the new information and understanding gained from these activities may change present notions on ANL-W's impacts to groundwater.

3.3.1 Snake River Plain Aquifer

Background water quality data from the SRPA are presented in Table 3-1. The groundwater sample was collected from well EBR-II no.1 (Figure 3-1 at end of this section), in October 1958. This sampling event was conducted before large-scale operations began at ANL-W. In their presentation of data, Robertson, et. al. (1974) pointed out that the pH, alkalinity and dissolved iron data are suspect. However, the data still provides reasonable, yet limited, background information for evaluating the effects of later INEL or ANL-W operations.

Groundwater samples representing background for the ANL-W area were also collected in 1988 and 1989 (Chen-Northern, Inc., 1989a). These samples were analyzed for organic and inorganic parameters from 40 CFR 264, Appendix IX and are presented in Table 3-2. This data was analyzed to full CLP protocol. Chain-of-custody and analytical request forms were used throughout. A Level VI data package was provided, but only Level C validation was performed. The groundwater samples were collected from three wells at or near ANL-W (EBR-II #1, EBR-II #2 and Arbor Test) (Figure 3-1).

Organic compounds were detected in the Chen-Northern background groundwater samples; however, these organics were considered contaminants introduced during field collection or laboratory analysis based on data evaluation of similar detections in trip, field, and laboratory blanks. Inorganic parameter analysis of groundwater yielded trace concentrations of As, Ba, Cu, Se, Tl, V and Zn. The concentrations were within expected values for natural groundwater. The inorganic background concentrations for groundwater at or near the ANL-W are also listed in Table 3-2. The elevated zinc level in the Arbor Test Well (ATW on Table 3-2) is attributed to the use of galvanized discharge pipe in the well. None of the detected radionuclides exceeded respective MCL's.

Since 1989, three new wells, ANL-MON-A-11, ANL-MON-A-12 and ANL-MON-A-13, have been installed to the aquifer. Well ANL-MON-A-11 (M-11) was installed as part of the EBR-II Leach Pit (ANL-08) characterization in 1991. It is located approximately 300 feet down gradient of the Leach Pit. Well ANL-MON-A-12 (M-12) is up gradient of the facility and represents background conditions. Well ANL-MON-A-13 (M-13) is approximately 1000 feet down gradient of the IWP (ANL-01A).

Table 3-1 Chemical Analysis of Background Water Quality at ANL-W.

CHARACTERISTICS	CONCENTRATION (mg/L, unless noted)
Temperature	54°F
Specific Conductance	293(μmhos @ 25°C)
pH	7.7
Total Dissolved Solids	192
Calcium	32
Magnesium	9.7
Sodium	14
Potassium	3.0
Bicarbonate	149
Carbonate	0
Sulfate	13
Chloride	12
Nitrate	1.9
Fluoride	0.7
Silica	33
Dissolved Iron	0.25
Total hardness (as $CaCO_3$)	0

Table 3-2 Chemical Analysis of Water Quality at ANL-W.

(From Chen-Northern 1989a)

(All values in µg/L)	PW-1[a,h]	PW-2[b,h]	PW-4[c,h]	PW-2D[d,i]	PW-5[e,i]	ATW[f,h]	ATW-B[g,i]
Methylene Chloride	11 B[j]	6 B	34 B	7 J[k]B	21 B	ND[l]	ND
Acetone	ND	ND	110 B	3 JB	4 JB	ND	ND
Di-n-butylphthalate	3 JB	ND	ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	ND	ND	ND	3 J	ND	ND	8 JB
Chloroform	ND	ND	8	ND	ND	ND	ND
Trichlorofluoromethane	ND	ND	5	ND	ND	ND	ND
2,6-bis(1,1 dimethyl)Phenol	ND	ND	ND	8	ND	ND	ND
N-Nitrosodiphylamine	ND	ND	ND	8 JB	ND	[m]	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND		1 J
Antimony	< 5.0	< 5.0		<30.0		<30.0	
Arsenic	< 3.5	< 3.5		< 2.0		2.4	
Barium	37.0	37.0		33.0		34.0	
Beryllium	< 5.0	< 5.0		< 1.0		< 3.0	
Cadmium	< 5.0	< 5.0		< 5.0		< 5.0	
Chromium	< 10.0	< 10.0		< 10.0		< 10.0	
Cobalt	< 50.0	< 50.0		< 20.0		< 23.0	
Copper	< 20.0	< 20.0		< 10.0		20.0	
Lead	< 2.1	< 2.1		< 3.0		< 5.0	
Mercury	< 0.2	< 0.2		< 0.2		< 0.2	
Nickel	< 24.0	< 24.0		< 20.0		< 19.0	
Selenium	< 2.5	< 2.5		< 3.0		2.4	
Silver	< 2.5	< 2.5		< 5.0		< 2.0	
Thallium	< 3. 0	< 3.0		< 3.0		2.5	
Vanadium	< 20.0	< 20.0		< 10.0		13.0	
Zinc	< 20.0	< 20.0		14.0		437	
Tin	< 114	< 114		< 20.0		< 114	
Phenol	3	< 5		< 5		< 5	

[a] Production Well EBR-II no. 1.
[b] Production Well EBR-II no. 2.
[c] Trip Blank.
[d] Duplicate from well EBR-II no. 2 .
[e] Trip Blank.
[f] Arbor Test Well.
[g] Trip blank.
[h] Analyzed by Envirodyne Engineers, Inc.
[i] Analyzed by International Technology Corporation (IT).
[j] B - value is above instrument detection limit but below contract required detection limit (CRDL).
[k] J - value is an estimated concentration.
[l] ND - Constituent was not detected (less than CRDL and insrument detection limits)
[m] Blank spaces indicate constituent was not analyzed for.

Well M-11 and the two production wells (EBR-II #1 and #2) were sampled quarterly in 1993 for the full list of 40 CFR 264, Appendix IX constituents plus specific INEL water quality parameters. Wells M-12 and M-13 were sampled quarterly in 1995. Samples from these two wells were also analyzed for the full list of 40 CFR 264, Appendix IX constituents and INEL specific parameters. Well M-12 was completed in 1993 and was to be sampled quarterly starting in 1994. A single sample was collected from well M-12 in 1994 and analyzed for the full list before equipment problems shutdown the program for the remainder of the year. Validated data from all sampling events are presented in Appendix H.

Only sporadic detections of various constituents have been made in the ANL-W monitoring well network over time. These include five organic constituents, selected inorganic constituents related to water quality and general radionuclides.

Only two organic constituents (Bis-2-(Ethylhexyl) phthalate and Endosulfan II) have been observed above method detection limits. Bis-2-(Ethylhexyl) phthalate is a common laboratory contaminant and is also used as a plasticizer. This compound has been detected in all wells at the site at concentrations from 370 µg/L to an estimated concentration of 29 µg/L. Levels have dropped consistently from May to October 1995. Investigation of sampling records suggests that these detections correlate with the use of a new Teflon sample splitter. The new sample splitter was first used during the May sampling of wells M-12 and M-13. Thus, it follows, that the May samples exhibit the highest concentrations. It should be noted that semivolatiles were in the first set of samples collected. Samples from wells M-11 and the EBR-II production wells occurred later that month and show much reduced levels, roughly one-fifth previous levels. The July samples from wells M-12 and M-13 show a continued reduction over the May samples of about one-half. Finally the October samples record estimated values about a third lower than in July.

Estimated detections of the three organochlorine pesticides, Endosulfan I, Endosulfan II, and Dimethoate, have been shown in wells M-12 and M-13. Records indicate that none of these pesticides have been used at ANL-W. The exact source of these constituents is unknown.

Acetone has been detected at an estimated level of 9µg/L to 12µg/L in wells M-12 and EBR-II #2, respectively. Acetone is a common contaminant and often appears in samples. Because levels in the blank samples were at 10µg/L it is believed that these detections are a result of laboratory contamination.

A wide variety of inorganic constituents have been detected over the course of sampling. Only barium, calcuim, magnesium, potassium, sodium, vanadium and zinc are consistently detected at levels above instrument detection limits. Occasional detections above instrument

levels of arsenic, chromium, copper and selenium have also been made. Of all these calcium, magnesium, potassium and sodium are essentially non-toxic under environmental exposure scenarios and can be eliminated from further discussion. The arsenic, barium, copper, manganese, selenium and vanadium are believed to be naturally occurring since they appear at comparable levels in all wells and with those of previous sampling. Since the detections of chromium are only associated with the older wells (EBR-II #1, and #2 and M-11), this most likely represents small amounts of leaching of chrome from the stainless steel components of the wells.

The following is a discussion of an evaluation of each well against background levels as recorded in well M-12. Well M-12 itself shows slightly elevated values over those of 1958. Levels of calcium, magnesium, sodium and potassium are generally 2000 to 6000 µg/L higher. This rise is most likely attributable to lower detection limits and more accurate instruments. Levels of barium in this well are higher than any other well. They are 10 to 20 µg/L higher than other wells or the 1989 sampling. Levels of the other constituents are comparable to the 1989 results. The elevated zinc levels in this well are attributable to the use of galvanized discharge pipe. It is hoped that at some point in the future at least that portion of the discharge line in the water will be replaced with stainless steel.

Well EBR-II #1 shows comparable levels of arsenic,, chromium, selenium and vanadium. Concentrations of barium and zinc are lower than in well MW-12. The higher iron is a result of the use of perforated carbon steel casing in the well as opposed to stainless steel. Of all constituents analyzed only calcium and potassium are slightly elevated above the 1958 and 1989 levels. All constituents are similar to those found in the other down gradient wells.

Well EBR-II #2 shows similar levels of arsenic, chromium, copper and vanadium to those from other wells. Concentrations of barium and zinc are lower. The single detections of chrome, mercury and those of vanadium are all less than the detection levels of the 1989 data. It is therefore impossible to tell if these are elevated levels. There is a strong possibility that all three of these constituents are due to laboratory variation since they occur in all wells sampled during the same event.

Well M-11 exhibits comparable levels of arsenic, chromium, copper and vanadium to those of the up gradient well. Levels of zinc are slightly lower than in the up gradient well. Barium is lower than that in M-12 by approximately 20 µg/L. All analyzed constituents are comparable with those from other wells and the 1989 levels.

Well M-13 shows levels of arsenic, copper and vanadium similar to those of well M-12. Levels of barium are lower than M-12 but comparable to the other wells. Barium is at a level

about the same as those in 1989 and is similar to the levels in other wells. Most of the other analyzed constituents levels are lower than the 1989 detection limits.

The only radionuclides consistently detected in ANL-W wells are Americium-241, Neptunium-237, Uranium-234 and Uranium-238. The occurrence of Americium and Neptunium are believed to actually represent detections of two naturally occurring radionuclides (Radon-222 and Radium-226). This is supported by noting that the activities are virtually identical. The alpha energy of Americium-241 is 5.4857 MeV while that of Radon-222 is 5.4895 MeV, a difference of 0.0038 MeV. Likewise, the associated energies of neptunium and radium are 4.788 MeV and 4.784 MeV, respectively. Further support for this position is that plutonium isotopes have never been detected in any groundwater samples and that the americium and neptunium often occur as a detection of one or the other. For these two radionuclides to be manmade products, since they are related daughter products, both would be consistently detected and plutonium isotopes would be found. However, the random detections of these two do mimic the relation of radon and radium decay.

The occurrence of the uranium isotopes is to be expected in a mafic basalt terrain such as the Snake River Plain. Of the two isotopes Uranium-234 is the only one consistently detected. An analysis of the respective activites of U-234 and U-238 shows that these two are occurring at levels that would be expected for a natural system.

3.3.2 Vadose Zone Water Quality

Only limited information is available on vadose water quality. Sampling done during characterization work on the IWP in 1987 was the only time enough water could be collected for analysis. Shallow well M-5 as shown in Figure 3-4 was the only well to provide sufficient water for sampling during this time. The well was bailed at a rate of approximately .5 gpm. Since that time other attempts to collect a sample have been unsuccessful since the well only occasionally retains a trace (< 6 inches) of water. Results from this event are listed in Table 3-3.

Water from the Industrial Waste Pond and the vadose water can be differentiated from water derived from the SRPA, in the ANL-W area. Pond water and vadose water are a mixed cationic (calcium-sodium sulphate) type, whereas ground water from the SRPA is characterized as a single cationic, calcium bicarbonate type (Chen-Northern, Inc., 1988). The similarity in cation percentages between the pond water and the vadose water samples strongly suggests that the vadose water was derived from downward seepage of pond water.

3.4 Monitoring Wells

Monitoring wells at ANL-W are separated into two categories. The first is existing monitoring wells at or near ANL-W and the second is proposed additional monitoring wells. Currently ANL-W has monitored one monitoring well up gradient (M-12) and four wells within or down gradient of the ANL-W facility (M-11, M-13, EBR-II #1 and #2). Access has also been granted by the USGS to wells USGS 100 and Arbor Test if the need arises. ANL-W is proposing only one new monitoring well as part of this WAG 9 Comprehensive RI/FS Work Plan. Further details on the existing and proposed monitoring wells can be found in Section 3.4.1 and 3.4.2.

3.4.1 Existing Monitor Wells

Figure 3-1 at the end of section 3 shows the location of all aquifer wells near ANL-W. For purposes of this Work Plan wells M-11, M-12, M-13 and EBR-II #2 are proposed for continued monitoring for detection of possibly released contaminants. Well logs of all existing wells are provided in Appendix I.

3.4.2 Proposed Monitor Well(s)

The location of additional well(s) would be determined using the best available data and located to detect releases from any potential source indicated by a comprehensive risk assessment. This Work Plan recommends the addition of one new monitoring well at the ANL-W facility for monitoring conducted under the FFA/CO. This new well will be located down gradient of the MCTBD inlet. The proposed monitoring network will be further evaluated after the RI/FS baseline risk assessment (BRA) calculations are completed. Should the BRA results indicate an unreasonable risk, the need for installing additional monitoring wells will be assessed. The installation for any new well is subject to fund appropriations from the DOE-CH field office and approval by ANL-W management.

3.4.3 Analytical Evaluation of Proposed Monitoring Network

An analytical evaluation of the proposed monitoring network was conducted using the Monitoring Analysis Package (MAP) developed by Golder Associates for the DOE. This program has been used at both the Hanford site in Washington and at the INEL. The MAP program contains three separate programs. Two models are for contaminant plume evaluation and are not used in this evaluation. The third model is called the Monitoring Efficiency Model (MEMO). MEMO operates by generating hypothetical plumes from the defined source area and then determines whether a given network of wells detects those plumes. The model output consists of a shaded map showing the areas at the modeled site where a release would and would

not be detected and a calculated monitoring efficiency. MEMO derives monitoring efficiency from the ratio of the size of the area where the model detects a release to the total size of the source area. All analyses done for this plan used MAP version 1.1. A more detailed description of the MEMO model and process used is found in section 5.4.2.2 of the WAG-9 Groundwater Monitoring Plan (See Appendix D).

MEMO was used to evaluate the monitoring efficiency of the proposed monitoring network for major potential source areas at WAG-9. These source areas include the EBR-II Leach Pit (ANL-08), Industrial Waste Pond (ANL-01), Main Cooling Tower Blowdown Ditch (ANL-01A) and Industrial Waste Ditches A and C (ANL-01), Industrial Waste Lift Station Discharge Ditch (ANL-35) and the Sewage Lagoons (ANL-04). ANL-W evaluated each source as a separate unit to allow the use of a smaller source and buffer grid.

MEMO calculates hypothectical plumes based on longitudinal and transverse dispersivities, groundwater flow angle, contaminant concentration and detection limit, and source size. All parameters are user definable. The following table lists the values used for this analysis.

Parameter	Value
Groundwater flow direction	225°
Dilution contour (C_D/C_0)	0.02
Longitudinal Dispersivity	70 feet
Transverse Dispersivity	20 feet
Line source width	50 feet (250 feet at ditches)
Diffusion coefficient	zero
Decay constant	zero
Contaminant velocity	zero

It should be noted that the groundwater flow directions shown are not in standard compass convention (i.e., zero is north or up). MEMO records the flow directions in degrees measured counterclockwise from due east. Using this convention then North is 90°, West is 180°, South is 270° and East is 0°. ANL-W determined the groundwater flow direction from the equipotential map presented in Figure 3-3.

Since existing wells were modeled, no target efficiency was used. Runs were done to estimate efficiency of the current network. The results of each source run are presented in Figures 3-4 through 3-7. Shaded areas on the figures show areas that are not covered by wells. In Figure 3-4 the Sewage Lagoons have been evaluated. The well shown represents well EBR-II No. 2 and is approximately 1200 feet down gradient from the southwest edge of the lagoons. Monitoring efficiency was calculated at 100%. Figure 3-5 shows the EBR-II Leach Pit (ANL-08). The well shown represents well M-11 and is approximately 400 feet down gradient

from the southwest edge of the unit. Monitoring efficiency was again calculated at 100%. Figure 3-6 shows the Industrial Waste Pond (ANL-01). The well shown represents well M-13 and is approximately 1200 feet down gradient from the southwest edge of the unit. Monitoring efficiency was calculated at 97%. Figure 3-7 shows ditches A and C (ANL-01), the Main Cooling Tower Blowdown Ditch (ANL-01A) and the Industrial Waste Lift Station Ditch (ANL-35). The wells shown represent M-11 and M-13. They are approximately 500 feet and 1000 feet, respectively, down gradient from the edge of the unit. Monitoring efficiency was calculated at approximately 16%. While the ditch system has a low efficiency the initial discharge points of ditch C of ANL-01 and ANL35 are covered. These areas would be anticipated to be the locations of maximum contaminant concentrations. Appendix D of the WAG-9 monitoring plan includes listing of all input parameters for each MEMO run.

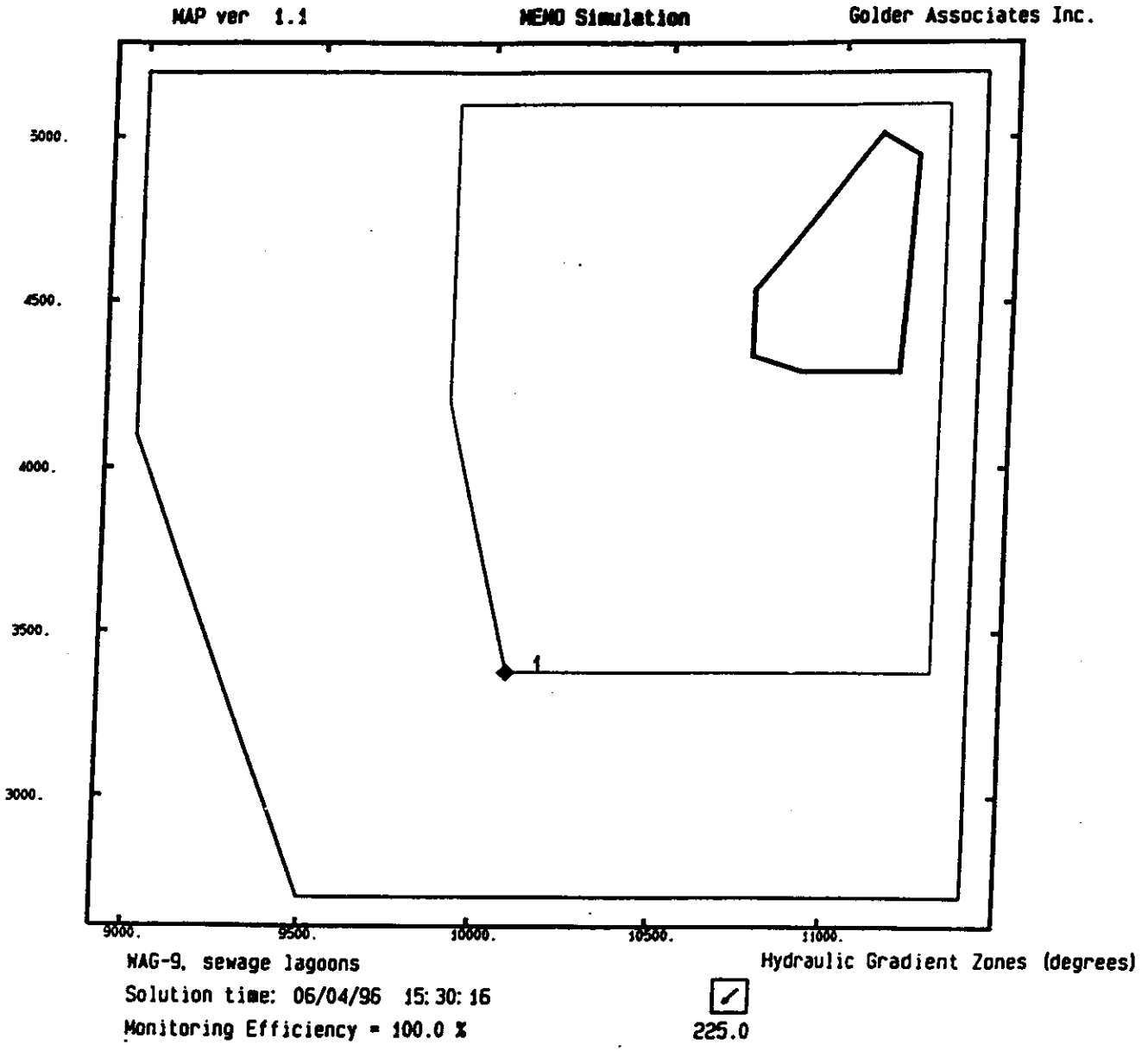

Figure 3-4 Monitoring Efficiency for the Sanitary Sewage Lagoons, (ANL-04).

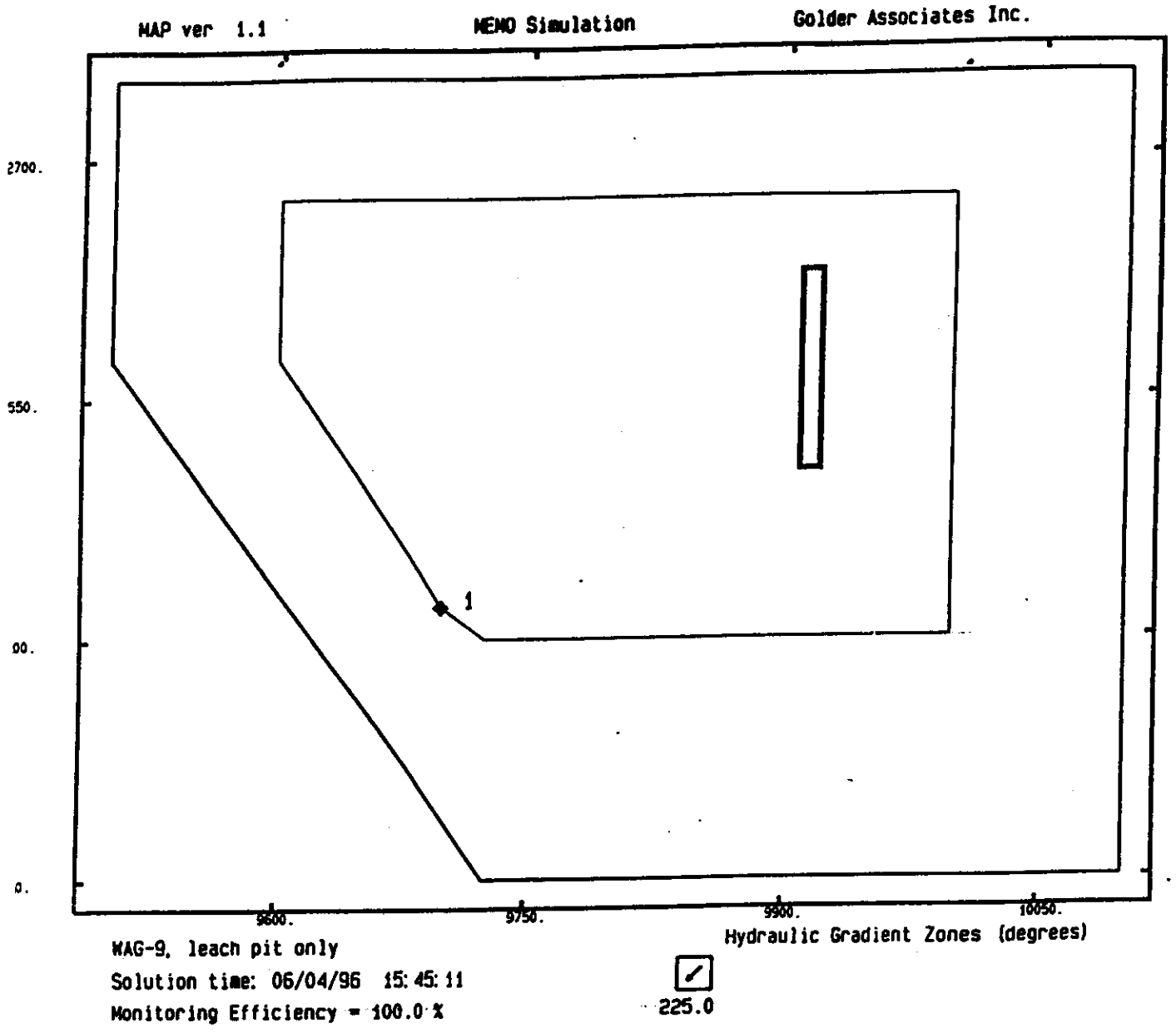

Figure 3-5 Monitoring Efficiency for the EBR-II Leach Pit, ANL-08.

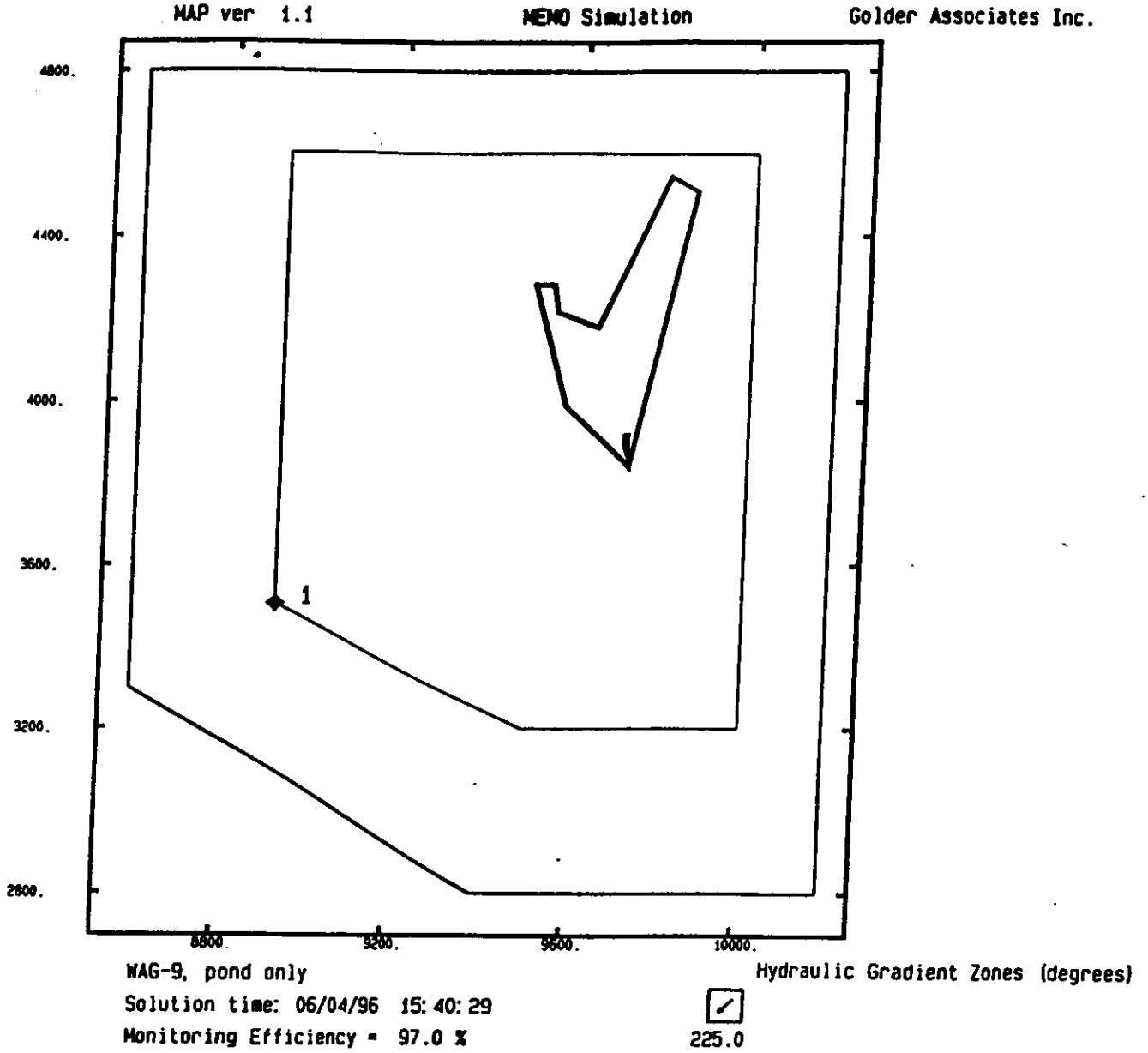

Figure 3-6 Monitoring Efficiency for the Industrial Waste Pond, ANL-01.

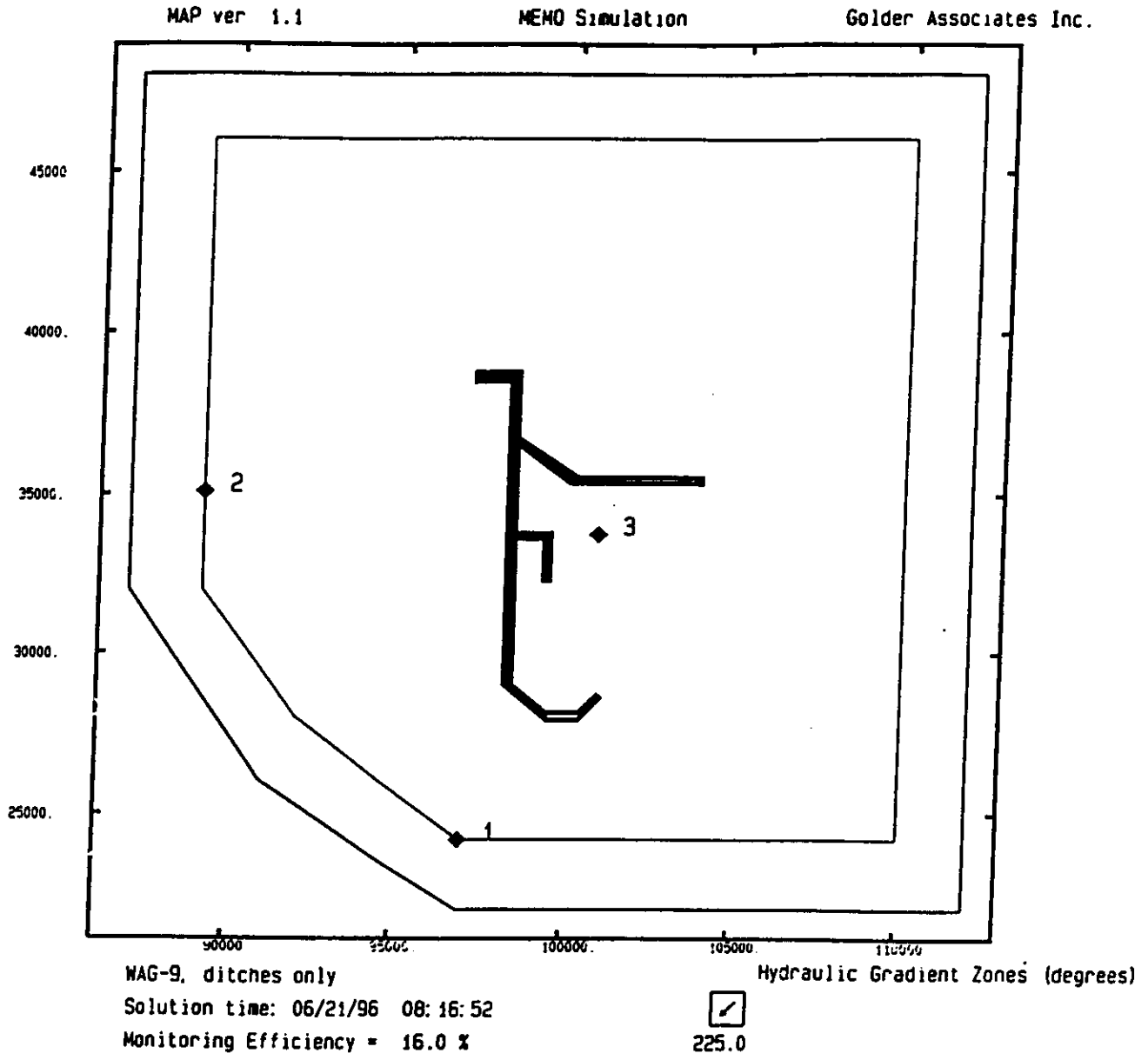

Figure 3-7 Monitoring Efficiency for the Industrial Waste Discharge Ditch, ANL-35, Main Cooling Tower Blowdown Ditch, ANL-01A, and Industrial Waste Ditches A and C, ANL-01.

3.4.3.1 Proposed Well Location Results

From the above results only the waste ditches apparently lack sufficient coverage. Runs were made to determine efficiencies with one and two additional wells (Figures 3-8 and 3-9). The addition of a single, optimally placed well had a dramatic impact, raising the network efficiency by more than 30%. The addition of a second well had only a small effect adding only and additional 15% to the calculated efficiency. This information with the MEMO analysis supports ANL-W's position that only one new down gradient well is justified based on cost benefit analysis.

In October 19, 1995 a letter was submitted to the IDHW-DEQ from DOE requesting that this site be reclassified from a Land Disposal Unit to a Solid Waste Management Unit. The IDHW-DEQ responded in a letter dated December 18, 1995 and denied the request for removal of the LDU designation for the MCTBD. "The closure of the MCTBD will follow CERCLA under the FFA/CO process with RCRA closure requirements [IDAPA 16.01.05.008 (40 CFR 264 Subpart G)] being strictly applicable." After further review of the FFA/CO agreement ANL-W has determined that if the MCTBD does not pose a risk greater than those specified in the National Contingency Plan the RCRA closure requirements will not be applicable.

3.5 Monitoring Parameters and Schedules

Under the INEL Groundwater Monitoring Plan, any new well will be monitored quarterly for one year for the full 40 CFR 264, Appendix IX constituent list and selected INEL specific parameters. Following the first year of quarterly monitoring, frequency and parameters will be reduced to semiannual monitoring for the INEL specific parameters and any Appendix IX parameters identified as valid detections for at least two quarters. Sampling frequency may then be reduced to annual at the discretion and consensus of the WAG-9 project managers and ANL-W.

The sampling schedule proposed under this Work Plan is based on past analytical results collected under the INEL Groundwater Monitoring Plan. Parameters for continued analysis will be the INEL specific list of water quality parameters, eleven metals, gross alpha, gross beta, gamma spectrometry, tritium, and uranium isotopes (Table 3-4). The four existing wells listed in section 3.4.1 will be sampled on a semi-annual basis.

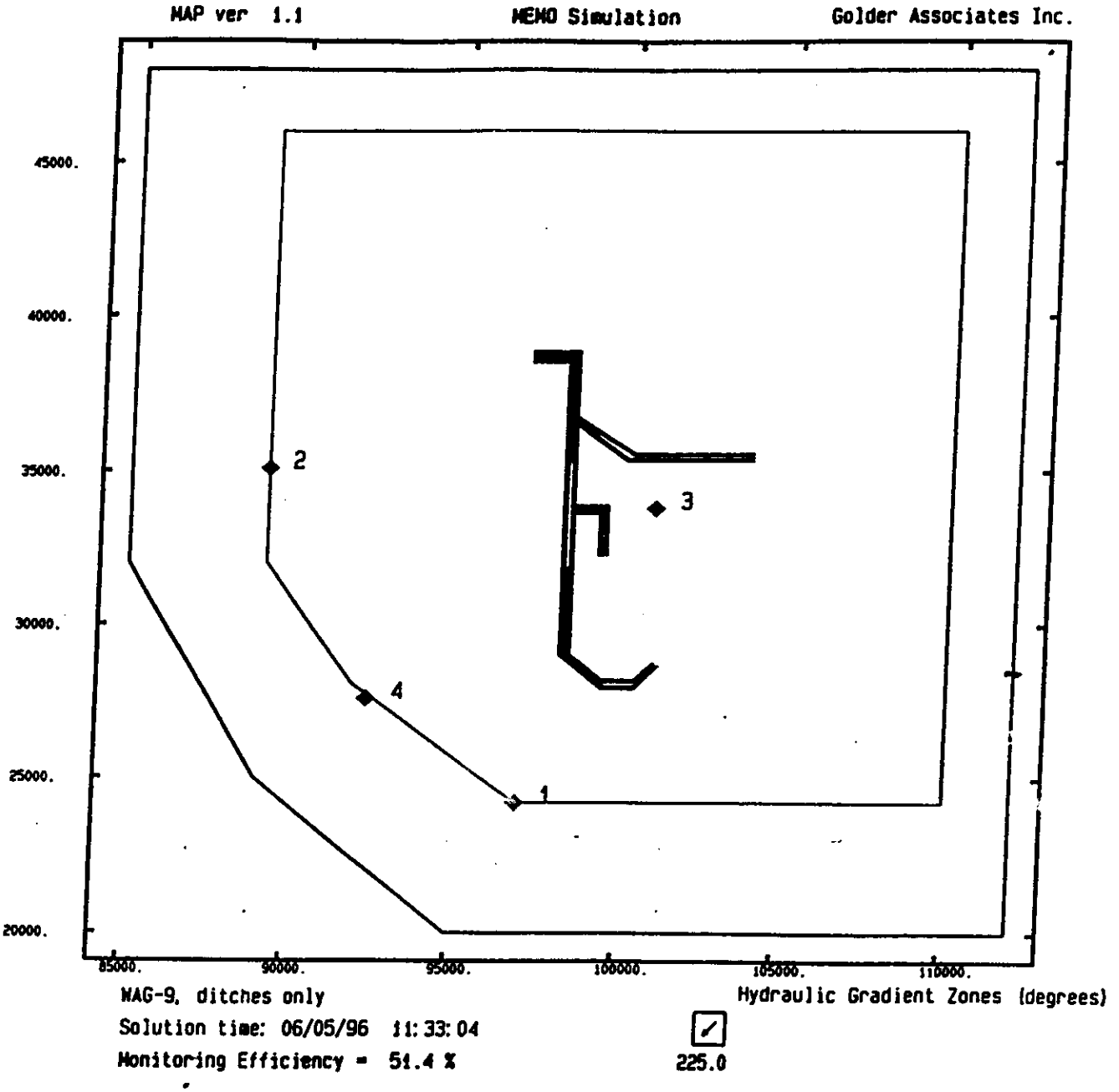

Figure 3-8 Monitoring Efficiency for the Industrial Waste Discharge Ditch, ANL-35, Main Cooling Tower Blowdown Ditch, ANL-01A, and Industrial Waste Ditches A and C, ANL-01, with one new well.

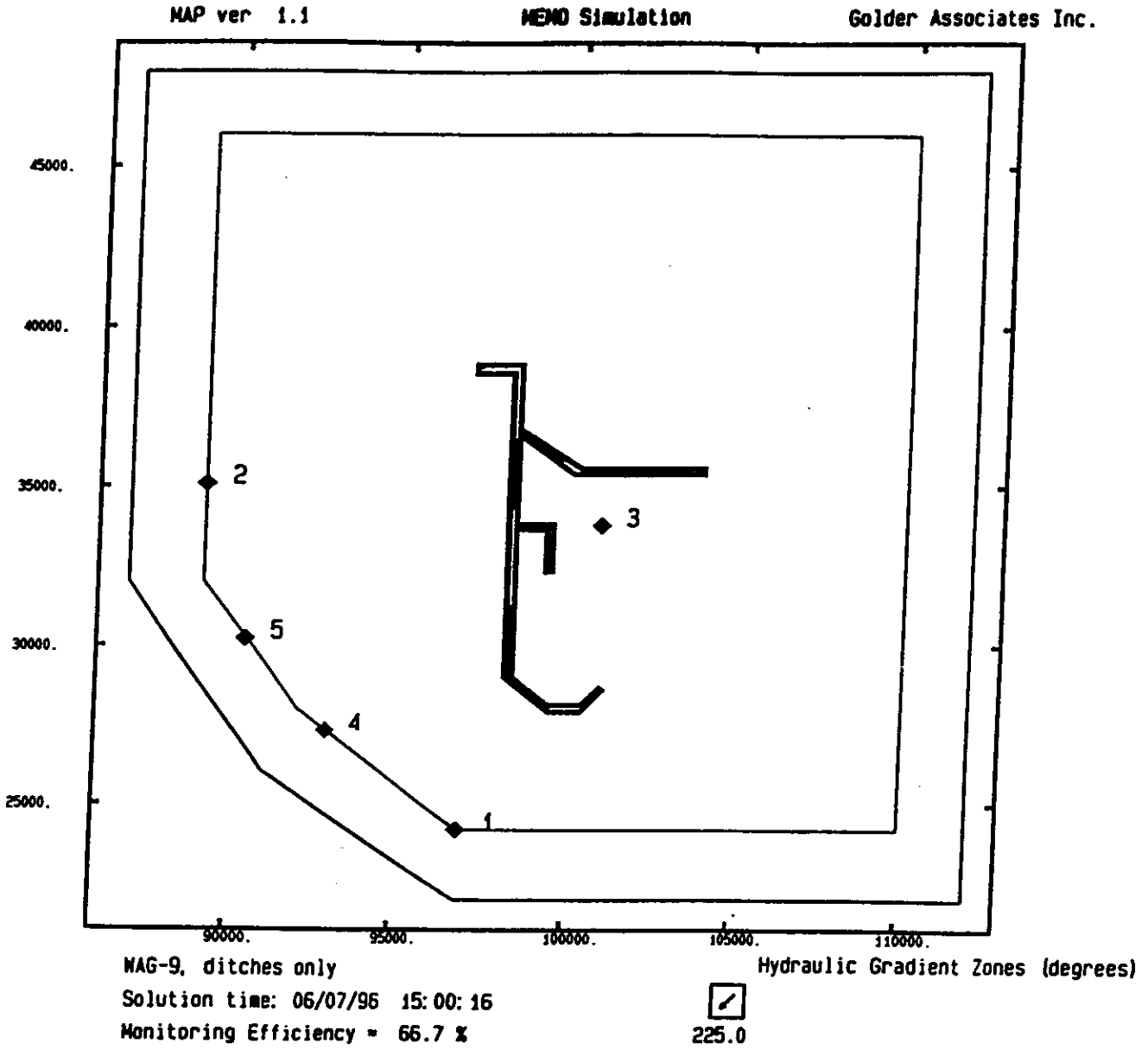

Figure 3-9 Monitoring Efficiency for the Industrial Waste Discharge Ditch, ANL-35, Main Cooling Tower Blowdown Ditch, ANL-01A, and Industrial Waste Ditches A and C, ANL-01, with two new wells.

Table 3-3 Vadose Water Quality Results.

PARAMETER	CONCENTRATION (μg/L)	MAXIMUM CONTAMINANT LEVEL[a] (μg/L)
Aluminum	ND[b] (125)	200
Antimony	ND (28)	6
Arsenic	10.1	50
Barium	83	2000
Beryllium	ND (5)	4
Cadmium	ND (5)	5
Calcium	98,600	---
Chromium	ND (10)	100
Cobalt	ND (20)	---
Copper	ND (20)	1000
Iron	75	300
Lead	ND (2.1)	50
Magnesium	30,400	---
Manganese	210	50
Mercury	ND (20)	2
Nickel	ND (24)	100
Potassium	15,000	---
Selenium	ND (2)	50
Silver	ND (2)	100
Sodium	74,300	---
Thallium	ND (2.2)	2
Tin	---	---
Vanadium	ND (20)	---
Zinc	ND (20)	5000
Cyanide	ND (5)	200
Sulfide	ND (1000)	---
Sulfate	---	250,000
Total Organic Carbon	5,100	---
Total Organic Halogens	17	---

[a] Maximum Contaminant Level includes Primary and Secondary MCLs, and MCLGs.
[b] ND - Compound was analyzed for but not detected, number in parenthesis is the sample quantitation limit.

Table 3-4 Proposed Monitoring Constituents for WAG-9

Parameter	Method	CRDL (mg/L)
pH	SW[3] 9040/9045	0.5 - 14.0
Specific Conductance	EPA 120.1[1]	N/A
Total Dissolved Solids	EPA 160.1	50.0
Total Organic Carbon	415.2/SW 9060	1.0/1.0
Total Organic Halides	450.1	0.005
Dioxins/Furans	SW 2890	0.01µg/L
Aluminum		
Antimony	EPA 200.8	0.0004
Arsenic	SW 7060	0.01
Barium	EPA 200.7/.8	0.002
Beryllium	EPA 200.8	0.0003
Cadmium	EPA 200.7	0.001
Calcium	EPA 200.7 or SW 6010	0.001/ 5.0
Chromium	EPA 200.7 or SW 6010	0.007/ 0.01
Cobalt		
Copper		
Iron	SW 6010 or EPA 200.7/236.1/236.2	0.1/0.01
Lead	SW 7421	0.005
Magnesium	SW 6010	5.0
Manganese		
Mercury	EPA 245.1/ .2	0.0002
Nickel	EPA 200.8	0.0005
Potassium	SW 6070	5.0
Selenium	EPA 270.2	0.002
Silver	SW 6010	0.01
Sodium	SW 6010	5.0
Thallium	EPA 200.8 or SW 7841	0.0003/ 0.01
Tin		
Zinc	SW 6010	0.02
Chloride	EPA 300.0[1] or SM[2] 407	0.5
Nitrate	EPA 300.0	0.01
Sulfate	EPA 300.0 or SM 426	0.2
Carbonate	SM 403 (w/alkalinity)	1.0
Bicarbonate	SM 403 (w/alkalinity)	1.0
Total Alkalinity	EPA 510.1	5
Uranium Isotopes		
Gross Alpha	SW 9310	10. pCi/L
Gross Beta	SW 9310	5. pCi/L
Gamma Spectrometry		

1 200 and 300 series methods in EPA-600/4-79-020, 1979

2 SM = Standard Methods for the Examination of Water and Wastewater

3 SW = SW846, EPA Method 8015 (EPA, 1986)

4 Prescribed Procedures for the Measurement of Radioactivity in Drinking Water (EPA 600/4-80-032), (EPA 1982).

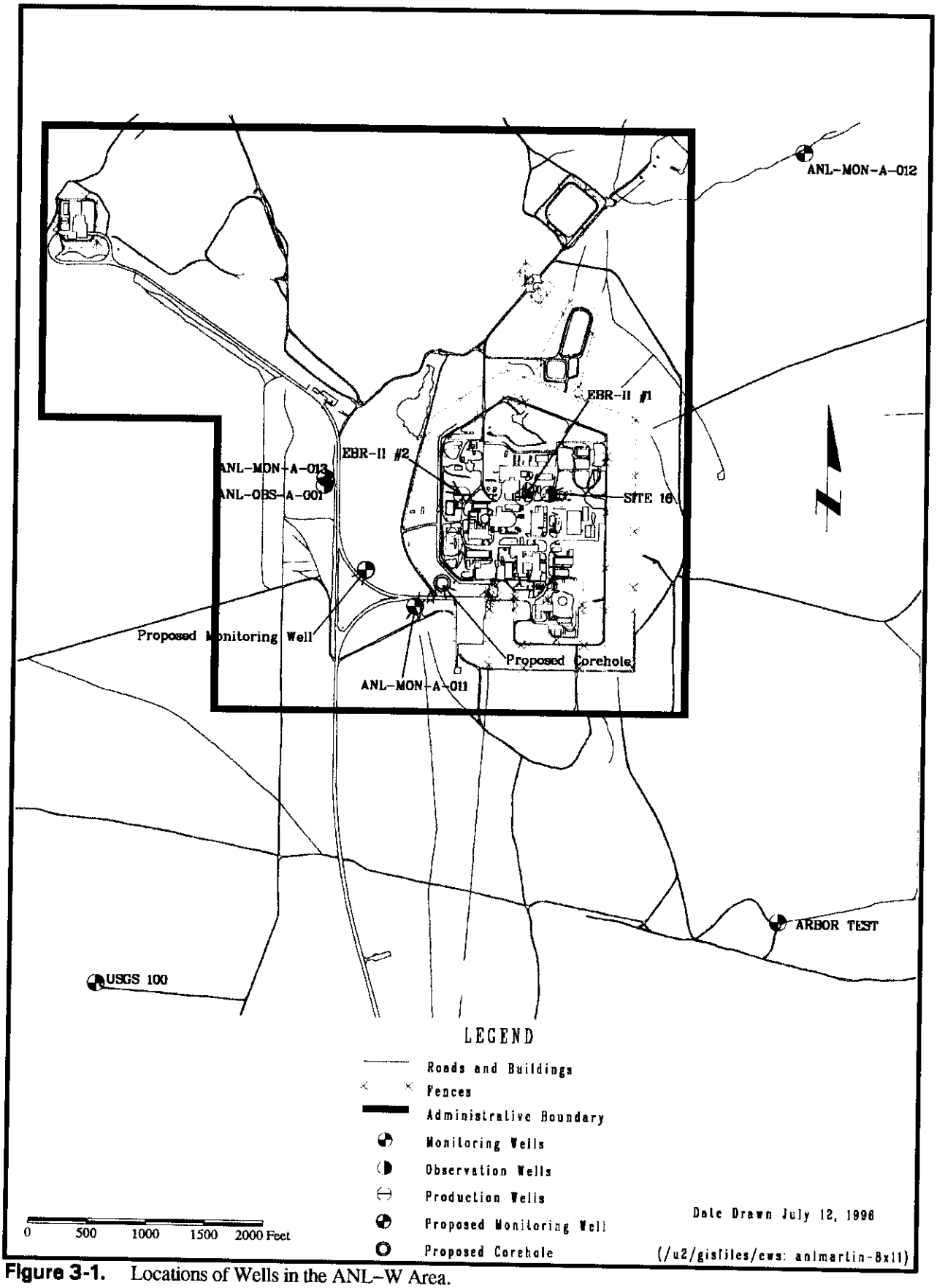

Figure 3-1. Locations of Wells in the ANL–W Area.

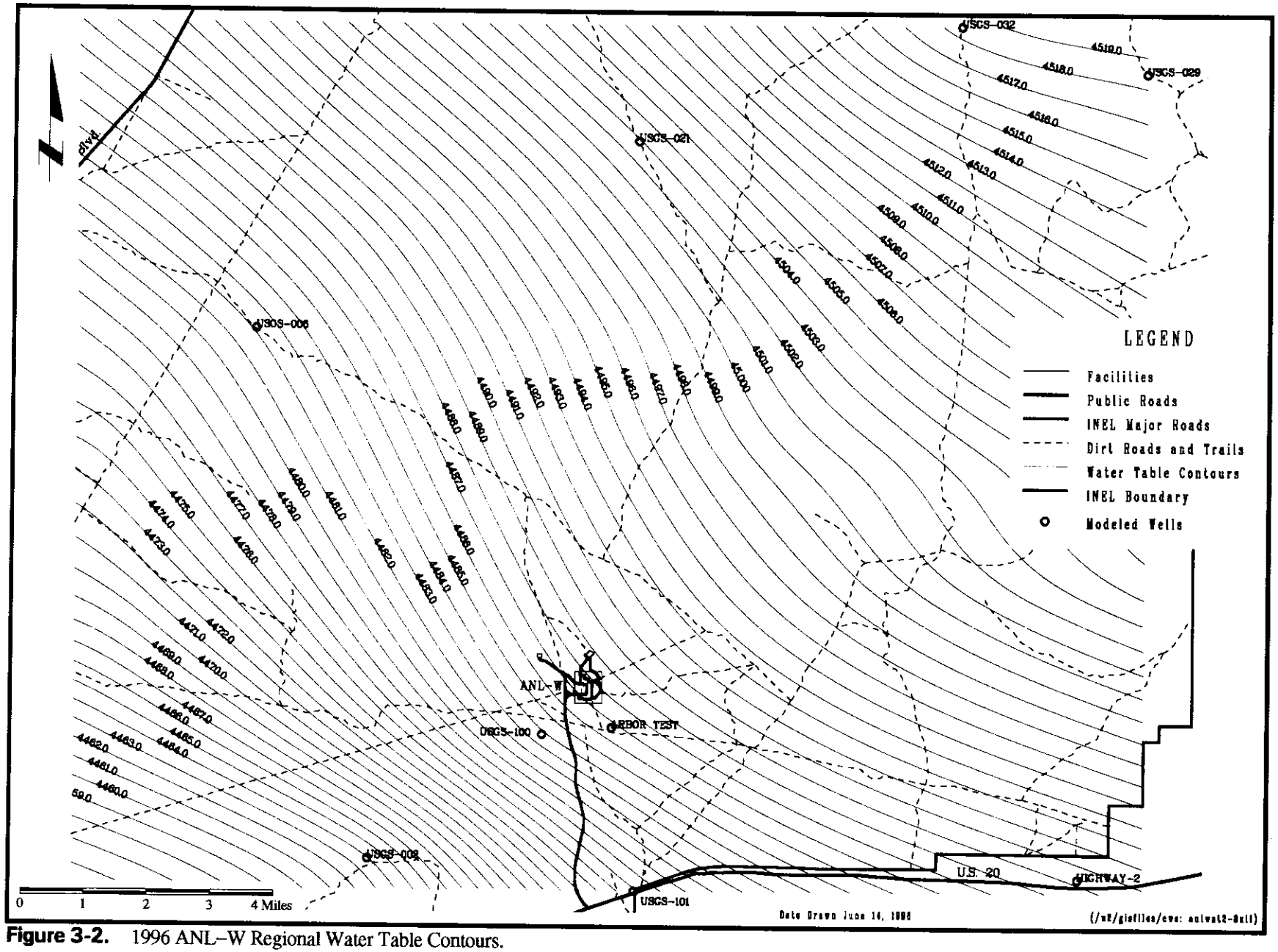

Figure 3-2. 1996 ANL–W Regional Water Table Contours.

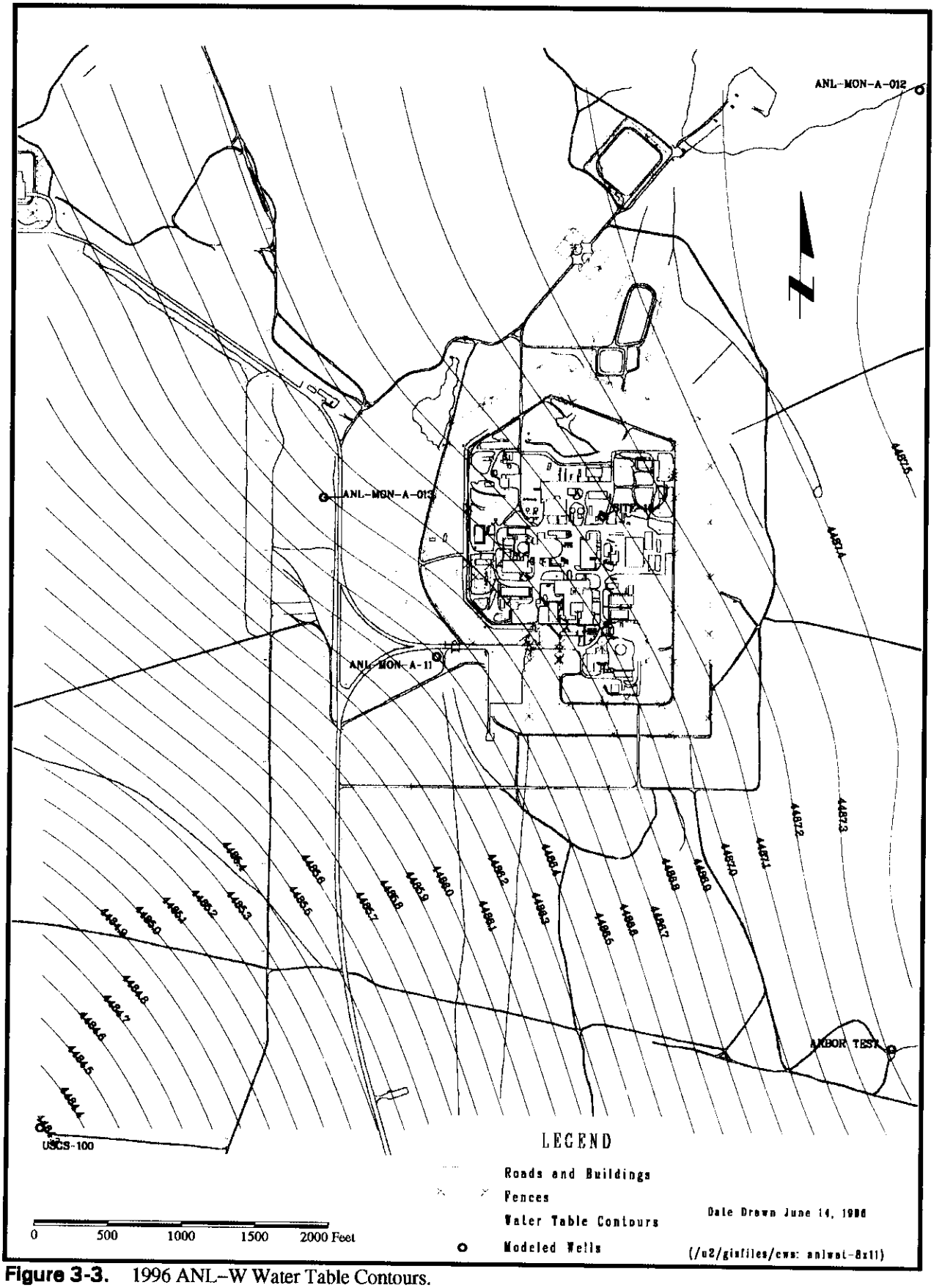

Figure 3-3. 1996 ANL–W Water Table Contours.

4 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

This screening level ecological risk assessment (SLERA) for Waste Area Group 9 (WAG 9) at the Idaho National Engineering Laboratory (INEL), was performed using the methodology developed in the *Guidance Manual for Conducting Screening Level Ecological Risk Assessments at the INEL* (VanHorn et al., 1995), subsequently referred to as the Guidance Manual. Those contaminants present at WAG 9 that have the potential to cause undesirable ecological effects were identified and those sites identified in the Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID, 1991) were evaluated. Any site for which there was inadequate sampling information to determine potential ecological effects was acknowledged. This SLERA is intended to support more detailed screenings and/or followup ecological risk assessments (ERAs) or other screening (if required) allowing subsequent efforts to be focused on the more important contaminants and sites.

4.1 Objectives

The objectives of the SLERA for WAG 9 were to:

- Identify those contaminants that may contribute to a potential ecological risk.
- Identify those sites that contain levels of contamination contributing to this possible risk.
- Indicate those sites for which additional data and/or monitoring is needed for performance of a more detailed ERA, if required, or finalization of the SLERA, if found to be a potential contributor to ecological risk through this initial screening process.

4.2 Scope and Organization

The U.S. Environmental Protection Agency (EPA) Framework (EPA, 1992a) stresses the importance of a step approach to ERA at Superfund sites. The SLERA assessment process applied for this analysis involves a three step approach that parallels the EPA *Framework for Ecological Risk Assessment* (EPA, 1992a): problem formulation, screening analysis and screening level evaluation. Each of these steps are described in the following sections. For a more detailed discussion of the approach, refer to the Guidance Manual (VanHorn et al., 1995).

4.3 Problem Formulation

The goal of the problem formulation of the ERA is to investigate the interactions between the stressor characteristics, the ecosystem potentially at risk, and the ecological effects (EPA 1992a). This process begins with a general description of the site and a characterization of the ecosystem at risk. Next, the potential stressors to the ecosystem are identified, the migration pathways of the identified stressors are modeled, and the potentially affected components of the ecosystem are identified. The ecosystem at risk and stressor characterization with exposure pathways are then assimilated into the conceptual site model. The problem formulation phase results in characterization of stressors (i.e., identification of contaminants), definition of the assessment endpoints, and ecological effects used to analyze risk using the ecological conceptual site model.

4.4 Risk Evaluation

The results of the Screening Level Quotient (SLQ) assessment shows that several mean levels of nonradionuclides contaminants exceed their corresponding Ecologically Based Screening Levels (EBSLs) for surface soils (Table 4-1 Appendix C). The SLQs for antimony, arsenic, chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, sodium and zinc are greater than 1.0. For the subsurface contaminants, the SLQs for 2-butanone, 2,3,7,8-TCDD, acetone, antimony, arsenic, beryllium, butylbenzylphthalate, chloroform, chromium, copper, cyanide, di-n-octylphthalate, lead, manganese, mercury, methylene chloride, nitrates, PCBs, silver, sodium, sulfates and zinc are greater than 1.0. This indicates that these contaminants may potentially cause adverse effects to populations of exposed ecological receptors and will need to be addressed further in the ERA or subsequent screening.

The results of the SLQ assessment shows that the mean concentrations of radionuclides do not exceed their respective EBSLs for internal exposure from surface and subsurface soil (Tables 4-3 and 4-4 in Appendix C). The results of the SLQ assessment of the external dose from soil contamination are shown in Tables 4-5 and 4-6 of Appendix C. The SLQs for none of the mean concentrations of Cs-137 exceeds its respective EBSL for external exposure from subsurface soil.

As discussed in Section 2.4.3 and 3.1.2 of Appendix C, the radionuclides and several of the nonradiological contaminants identified as present at the Industrial Waste Pond and three Cooling Tower Blowdown Ditches, the Industrial Waste Lift Station Discharge Ditch and the ANL Sewage Lagoons may potentially cause adverse effects to populations of ecological receptors. These sites will need to be addressed further in the ERA.

4.5 Summary of SLERA

The objectives of this SLERA were to identify those sites of concern, the contaminants and to identify data gaps. During the performance of the SLERA, the values for the Track 1 and 2 results (either the maximum or the UCL) were used to determine potential risk to ecological receptors. This will result in more conservative results than if the actual data was assessed. Most sites did have some data available to assess. If a new contaminant is subsequently identified then development of the associated EBSLs will be required. If the average for a contaminant sampled subsequent to this SLERA is greater than the average addressed by this analysis, that contaminant must be reanalyzed even if it had been previously eliminated.

Subsequently, it should also be possible to examine the sites that are contributing the most to the contaminant average and to perform a more refined spatial analysis. At a limited scale this could be included in the final ERA for this WAG.

The most noticeable data gaps occur in the ecological based knowledge, such as Bio-Acumulation Factors (BAFs), Plant Uptake Factors (PUFs) and Toxicity Reference Values (TRVs). Of concern are the lack of BAFs and PUFs for all contaminants in general. The lack of TRVs for certain functional groups and the conservatism inherent in the TRV development will also need to be addressed in the ERA. This is particular true for those functional groups representing insectivores and carnivores. A more thorough literature search may yield the information necessary to make more realistic decisions concerning these values. This may eliminate the potential risk that is evidenced in the case of the carnivores, and provide the information necessary to perform the analysis, in the case of insectivores. It may be desirable to perform site specific data collection aimed at gathering information directed at these functional group data gaps.

SLERA endpoints for WAG 9 nonradionuclides were not attained. That is, all SLQs are not less than 1. The frequency with which the SLQs exceeded one is listed for each contaminant on Tables 4-1 and 4-2 of Appendix C. In surface soils, the SLQs for antimony, arsenic, chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, sodium and zinc exceeded the SLERA endpoint for 40% to 100% of the functional groups and T/E species. In subsurface soils, the SLQs for 2-butanone, TCDD, acetone, antimony, arsenic, beryllium, butylbenzylphthalate, chloroform, chromium, copper, cyanide, di-n-octylphthalate, lead, manganese, mercury, methylene chloride, PCBs, silver, sodium, sulfate and zinc exceeded one for 23% to 100% of the functional groups and T/E species. Additionally, SLQs could not be developed for some contaminants and receptors because toxicological information was unavailable. Consequently, no management decisions regarding actual risk from nonradionuclides can be made using this SLERA.

For radionuclides, the SLERA endpoints (SLQs were less than 0.1) were attained for all functional groups and T/E species (see Tables 4-3 through 4-6 of Appendix C).

It will be necessary to incorporate any additional site contaminant data as data collection is finalized. For six (ANL-04, ANL- 05, ANL-01, ANL-01A, ANL-09 and ANL-35) of the ten sites of concern listed on Table 2-2 of Appendix C, extensive data collection has been performed. Also, for a seventh site, ANL-61A, six samples were collected, two of which showed PCB contamination in subsurface soil. However, for the remaining three sites (ANL-29, ANL-36 and ANL-62) little or no data was available. Single data points for ANL-29 and ANL-36 were located in the MAX data base[2] (Rood, 1994). These indicated that silver was present in the subsurface and surface soil, respectively, at these sites. No data was located for ANL-62. Although these sites are considered to have only minor potential for environmental risk, site contaminant data should be collected and screened for risk to ecological receptors.

For those functional groups determined to be at potential risk as a result of this screening, the first step is to determine if it is possible to use the site specific data available from sources at the INEL. A more detailed discussion of the sites that are driving the analysis should be included potentially using a limited spatial analysis. Use of site specific data, instead of conservative assumptions, would allow a more realistic interpretation of the potential risk.

4.6 Transition from SLERA to ERA

The results of this SLERA will support performance of an ERA or other screening, if necessary, to be included in the Remedial Investigation/Baseline Risk Assessment (RI/BRA) for OU 9-04. Additional data (i.e., BAFs, TRVs, PUFs) identified through a more comprehensive literature search will be incorporated in the ERA.

Very conservative assumptions were applied in conducting this SLERA to identify all WAG 9 potential sites and contaminants of concern and those ecological receptors having highest potential for being adversely affected as a result of exposure to those sites/contaminants. Subsequent efforts will be focused on those WAG 9 contaminants and sites shown to be potential contributors to ecological risk. A more detailed analysis of risk using existing SLERA data, site-specific biological factors, and more possibly complete analytical data will be conducted in the ERA or other screening. Subsequently, less conservative, more realistic risk estimate values can be calculated and management decisions regarding ecological risk can be formulated.

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[2]. Personal Communication: S.M. Rood to E.C. Miller, EG&G Idaho, April 11, 1994, SMR-07-94.

4.7 Planned Work for Filling ANL-W Data Gaps Outlined in the SLERA

The activities that are necessary to fill in the data gaps are identified in the Screening Level Ecological Risk Assessment (SLERA). This new information will be incorporated into the SLERA to form a Waste Area Group (WAG 9) Ecological Risk Assessment (ERA). The ERA is a mandatory section of the WAG 9 Remedial Investigation / Feasibility Study (RI/FS).

4.7.1 Known Data Gaps

The data gaps identified in the WAG 9 SLERA include development of site-specific ecological based screening levels (EBSLs) and evaluation of aquatic and sediment-associated pathways and receptors. The WAG 9 SLERA identified 53 contaminants of concern (COCs) in at least one of four media types (surface water, sludge/sediment, surface soil and subsurface soil). For the WAG 9 ERA which is part of the RI/FS, ANL-W will require a more in depth study of these COCs.

The SLERA also included an evaluation of effects of COCs to threatened and endangered species potentially found at WAG 9. These threatened or endangered species recorded on the INEL include the: Bald eagle, Black tern, Burrowing owl, Ferruginous hawk, Loggerhead shrike, Long-eared myotis, Pygmy rabbit, Sage brush lizard, Small-footed myotis, Townsend's western big-eared bat, Trumpeter swan and White-faced ibis. A site tour and field survey (speciation of animals and plants, animal counts and habitat evaluation) should be performed to determine if any of the threatened and endangered species actually inhabit WAG 9, and determine the percentage of the year spent at WAG 9.

4.7.2 SLERA Work Breakdown

Perform a field survey to determine if any threatened and endangered species identified as possibly being present at ANL-W are actually present. This would be a simple two week study and include habitat evaluation, sightings and would qualify as a biological survey for the various agencies (e.g., U.S. Fish and Wildlife Service). This effort was started in June 1996.

Conduct a literature search of the 53 COCs identified in the SLERA for at least one of four media types (surface water, sludge/sediment, surface soil and subsurface soil) to identify screening criteria.

Evaluate the toxicity reference values (TRVs) used in the SLERA. Several conservative assumptions were used in the development of the TRVs in addition to using a limited data base. A more complete literature search will be performed for all 53 contaminants identified in the SLERA and used to develop more realistic TRVs for WAG 9.

After the TRVs have been revised, the COCs will be rescreened to determine what contaminants still indicate a potential for adverse effects to ecological receptors. Items listed in proposal 3 and 4 are designed to reduce the number of contaminants that would need to be evaluated in a field study.

For those contaminants which still indicate a potential for adverse effects to ecological receptors, a field study will be performed. The first step of the field study will be to develop an ecological sampling and analysis plan (approval from EPA and IDHW is not necessary). In an effort to reduce the scope of the ecological sampling and analysis plan, ANL-W will incorporate information on exposure factors, bioaccumulation and bioconcentration factors and plant uptake factors gathered from other INEL WAGs. Thus, the WAG 9 ecological sampling and analysis plan may include ,but is not limited to, developing WAG 9 specific: exposure factors (e.g., site use factor, exposure duration), bioaccumulation and bioconcentration factors and plant uptake factors.

4.7.3 Schedule for SLERA Work

Table 4-1 Work Schedule for Ecological Work at ANL-W

Work Item	Activity	# of Weeks
1	Field survey of sensitive species, site tour, Agency tour (e.g., U.S. Fish and Wildlife Service)	2
2	Conduct literature search for the 53 identified COCs	2
3	Evaluation of how the TRVs were calculated and develop more realistic TRVs using latest information from literature search	4
4	Using the more realistic TRVs to rescreen the 53 contaminants to determine which still indicate a potential for an adverse affect to ecological receptors.	2
5	For those contaminants which pose an adverse affect (Item 4) design an ecological sampling plan for characterization. The field sampling plan may include characterization of site specific exposure factors and data acquisition to determine bioaccumulation and bioconcentration factors, and plant uptake factors.	3
6.	Collection and analysis of the data specified in the ecological sampling and analysis plan.	4
7.**	Complete data validation and interpretation of sampling data.	3
8.**	Perform the WAG 9 Ecological Risk Assessment incorporating the results of the literature search, revised TRVs, sampling results, and the SLERA document.	10

* Estimated hours needed to perform each activity using best engineering judgement, past experience, and contractor estimates.

** Items 7 and 8 will be completed in FY 97 and the work will be performed after October 1, 1996.

4.7.4 Contaminants to be Evaluated at WAG 9

The list of 53 COCs identified in the SLERA for WAG 9 are shown in Table 4-2. Each of the contaminants are broken into the media type (surface water, sludge/sediment, surface soil and subsurface soil) in which the contaminant posed a threat to the ecological receptors.

Table 4-2 List of contaminants to be evaluated in the WAG-wide ecological risk assessment by media.

	Media			
Contaminant	Surface Water	Sludge/sediment	Surface Soil	Subsurface Soil
1,1,1-TCA		X		X
2-Butanone				X
2,4,5-TP		X		
Acetone				X
Aluminum	X	XX[a]		
Antimony	X	XX	X	X
Arsenic	X	XX	X	X
Barium	X	XX		
Beryllium	X	XX		X
Bis(2-ethylhexyl)phthalate		X		X
Bromoform	X			
Butylbenzylphthalate				X
Cadmium	X	X		
Calcium	X	XX	X	X
Chloride		X		X
Chloroform		X		X
Chromium	X	XX	X	X
Co-60	X	X		
Cobalt	X	XX		
Copper	XX	XX	X	X
Cs-137	X	XX		
Cyanide		XX	X	X
Di-n-butylphthalate		X		

	Media			
Contaminant	Surface Water	Sludge/sediment	Surface Soil	Subsurface Soil
Di-n-octylphthalate				X
Dicamba	X			
Fluoride	X	X		X
Iron	X	X		
Lead	X	XX	X	X
Magnesium	X	XX		
Manganese	X	X		X
Mercury		XX	X	X
Methylene chloride				X
Nickel		XX	X	
Nitrate	X	X		X
OCDD	X			
PCBs				X
Phosphate	X	X		X
Potassium	X	XX		
Pu-239	X			
Selenium		XX	X	
Silver	X	XX	X	X
Sodium	X	XX	X	X
Sr-90	X	X		
Sulfate	X	X		X
Sulfide		X		
TCDD				X
Th-228	X			
Th-230		X		
Toluene		X		X
Tritium	X			
Vanadium	X	XX		
Zinc	X	XX	X	X
U-238		X		

a. Contaminants marked "XX" indicate that it was detected at two sites.

5 FACILITY SCREENING OF POTENTIAL RELEASE SITES

A facility screening of all potential CERCLA hazardous substances release sites was conducted for WAG 9. The approach to facility screening at WAG 9 is adapted from the approach developed by DOE-ID, IDHW/DEQ and EPA WAG managers for WAG 3. The process was designed to ensure fulfillment of the requirements of CERCLA and evaluate the threat of release of hazardous substances to the environment. This process seeks to evaluate potential releases and to implement the D&D program under CERCLA, as specified by the DOE *Policy on Decommissioning Department of Energy Facilities Under CERCLA* May 22, 1995.

5.1 Screening Methodology

ANL-W used the five screening evaluation tables which were developed by WAG 3 at the Chemical Processing Plant. The ANL-W site plan which lists the facility name and building numbers is shown in Figure 5-1 at the end of Section 5.

The WAG 9 site was subdivided into three separate evaluations. In the first evaluation all tanks above ground and Underground Storage Tanks (USTs) were screened. The second screening evaluated all the ANL-W facilities (buildings, towers, and parking lots). In the third screening ANL-W evaluated all tanks used to store potentially radioactive liquids. The completed screening tables are in Appendix E for USTs, Appendix F for the facility screening and Appendix J for the radiological liquid storage tanks. ANL-W used four sources of information to complete the screening tables. The first was an ANL-W Surplus Inventory Assessment - Phase II (copy provided to regulators), the second was the ANL-W Termination Plan, the third the 1995 annual SARA Title III report of chemicals in each facility (Appendix G) and the last tours and interviews with ANL-W employees who operate these facilities.

5.2 Sites Retained

The tanks at WAG 9 were evaluated using the screening tables. These tables are shown in Appendix E. Of the 25 tanks that were evaluated all 25 were eliminated as potential release sites. Typically they were screened from further evaluation because they will be replaced prior to 1999 with above ground tanks and/or the ANL-W spill prevention, control and countermeasure program (section 2.5 of ANL-W Environment Safety and Health manual) provided a means of controlling a release. The screening process indicated that most WAG 9 tanks contained petroleum products. Most of the tanks in WAG 9 are used to supply diesel fuel to emergency generators for main facilities. These underground storage tanks will be removed or upgraded in accordance to Underground Storage Tank regulations by December 22, 1998. Until then the fuel volumes in the tanks are recorded weekly and compared with usage and fuelings. Typically the

emergency generators used at ANL-W have small day tanks located in the building thus eliminating the need to heat the large tanks during the winter. These small day tanks with less than 25 gallon storage capacity were eliminated because they did not exceed the reportable quantity threshold under IDAPA 16.01.02.851.

The screening of all 90 facilities at WAG 9 was conducted using the WAG 3 screening tables (Appendix F). Of the 90 facilities screened, only five were retained as potential release sites. These five facilities are; 764-ANL-W 200 foot stack, 765-Fuel Conditioning Facility, 768-Power Plant, 787-Fuel Assembly and Storage Building and 792-Zero Power Physics Reactor Mock-up Building. These were identified because they contained radioactive materials or could potentially release radioactive materials. A short description of each of these five facilities can be found in Section 5.2.1 through 5.2.5. These facilities will be qualitatively evaluated for CERCLA risks in the WAG 9 baseline risk assessment (BRA) uncertainty section. In addition, a discussion of operational design life, containment, monitoring and response capabilities will be provided where applicable for the facilities evaluated. Most of the facilities on the WAG 9 site are scheduled for decommissioning in 1998. All of the sodium currently stored at ANL-W will be treated at the Sodium Processing Facility under RCRA Part B permit application and all fuel (depleted and nondepleted) would be shipped off site for final disposal in accordance with the *Settlement Agreement* signed October 17, 1995, between the State of Idaho (Govenor Batt) and the Department of Energy.

ANL-W conducted the screening process on all 31 tanks at ANL-W which could contain or have contained potentially radioactive liquids. The screening tables of these 31 tanks are shown in Appendix J. All of these tanks are inside buildings in bermed areas and receive potentially radioactive liquids from decon showers, sink drains, janitorial mop water drains and condensate from air conditioners. These liquids are hard piped directly to the storage tanks. When the volume in the tanks reaches approximately 50 percent, the tanks are sampled for radionuclides, heavy metals and organics. If the sample results show no hazardous substances the water is pumped to the sewage lagoons for disposal. If only radiological contamination is present the wastes are pumped or trucked to the Radioactive Liquid Waste Treatment Facility. Other potentially radioactive liquid storage tanks receive their wastes from decontamination spray chambers and analytical testing fluids. These wastes typically contain radioactive liquids and are tested for hazardous constituents and pumped to the Radioactive Liquid Waste Treatment Facility for disposal (permitted RCRA TSD facility). All 31 tanks that currently contain or previously contained radioactive liquids were screened from the evaluation as shown in Tables 1-5 of Appendix J.

5.2.1 764-ANL-W 200 foot stack

The 200-foot Main Stack is located by the Fuel Conditioning Facility. The Main Stack is used to dispose of off gas products from FCF and the EBR-II reactor building. The stack is continuously monitored for radionuclides. HEPA filters are inplace to filter out radionuclide particles. Monitors are set to alarm if high detections of radionuclides are detected. ANL-W has procedures inplace to stop potential release activities after a high detection is encountered. The emissions from the stack are part of the annual air release report for the INEL. The monitors are not used as mitigory devices to prevent releases. They are only used to document that the air releases are within those specified in the operating permit. The stack is retained because of the potential to release radionuclides due to unforeseeable conditions in the FCF facility or the EBR-II reactor building.

5.2.2 765-Fuel Conditioning Facility

The initial purpose of the FCF was the demonstration of the fuel fabrication cycle for the Integral Fast Reactor (IFR) Project. The IFR project has been terminated. FCF will be utilized in the future for the treatment of EBR-II spent fuel and for demonstrating DOE spent fuel treatment technologies. These demonstration technologies started operation on Friday June 7, 1996. Monitors are set to alarm if high detections of radionuclides are detected. The monitors are not used as mitigory devices to prevent releases. They are only used to document that the air releases are within those specified in the operating permit. ANL-W has procedures inplace to stop potential release activities after a high detection is encountered. The site is retained as a potential site because the current demonstration operations pose the potential to release radionuclides through a catastrophic event.

5.2.3 768-Power Plant

The EBR-II Power Plant houses the electrical power generation and reactor support systems for the EBR-II reactor. The power plant currently is in standby mode and has an inplace sprinkler system for fire suppression. Chemicals are currently stored in appropriate cabinets located at various locations within building. Many of the chemicals are used for water chemistry and are individually packaged. Some of the water chemistry chemicals have already been moved to other buildings for use. This site is retained as a potential site because of the number and quantities of chemicals which are still in the facility. The chemicals in the building will be removed during the decommissioning. Final decommissioning of this facility is not known at this time. Current DOE long range plans are to place the EBR-II reactor in a radiologically and industrially safe condition.

5.2.4 787-Fuel Assembly and Storage Building

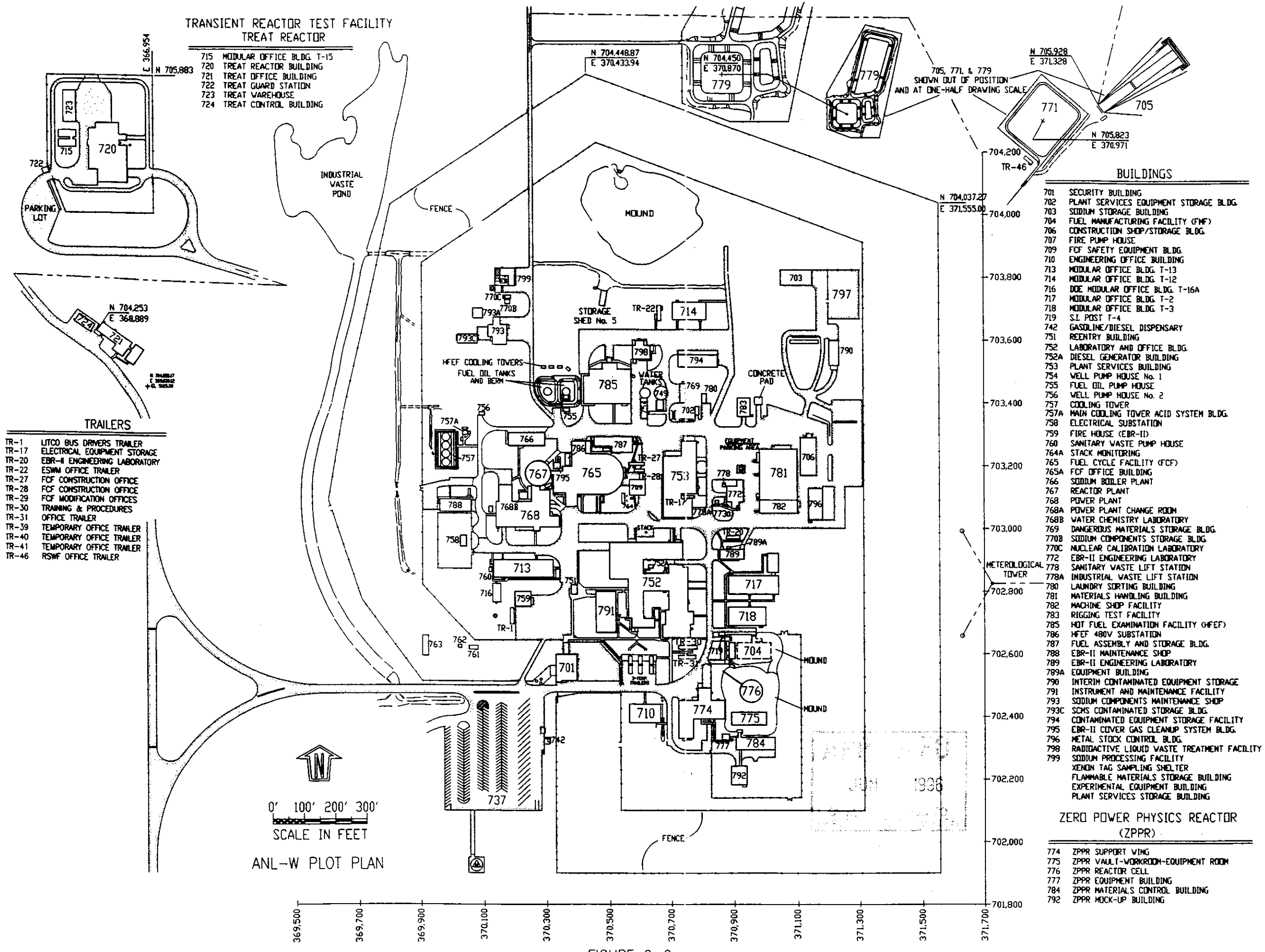
Fuel Assembly & Storage Building (FASB) contains the Reactor Materials Lab which consists of mechanical testing equipment and electron microscopes. Most of the household chemicals are in small containers and are currently stored according to manufacturer specifications. Disposal of any unused products is currently being completed as per RCRA regulations. The facility currently stores radioactive materials. The building is continuously monitored for air releases. This building is retained because the radioactive material has the potential to be released during a catastrophic event.

5.2.5 792-Zero Power Physics Reactor Mock-up Building

ZPPR Mock-up Building is part of the ZPPR complex and provides a storage area for reactor experiment materials and a work area for assembling drawers of experiment materials for use in ZPPR. The building houses radioactive materials (uranium oxide) used for fuel assemblies. This building is retained because the radioactive material has the potential to be released during a catostrophic event.

5.3 Summary

The facility screening for potential release sites at WAG 9 used the screening tables previously used at WAG 3. The WAG 9 site was divided into three separate studies; the screening of USTs, facilities and potential radioactive liquid storage tanks. All of the 25 USTs and 31 potential radioactive liquid storage tanks were eliminated from further evaluation as shown in Appendix E and Appendix J, respectively. Only five of the 90 facilities, as shown in Appendix F, were retained for further evaluation during the WAG 9 BRA. An assessment of the risks posed by these five sites will be evaluated qualitatively in the uncertainty section of the BRA.



TRAILERS

TR-1	LITCO BUS DRIVERS TRAILER
TR-17	ELECTRICAL EQUIPMENT STORAGE
TR-20	EBR-II ENGINEERING LABORATORY
TR-22	ESWM OFFICE TRAILER
TR-27	FCF CONSTRUCTION OFFICE
TR-28	FCF CONSTRUCTION OFFICE
TR-29	FCF MODIFICATION OFFICES
TR-30	TRAINING & PROCEDURES
TR-31	OFFICE TRAILER
TR-39	TEMPORARY OFFICE TRAILER
TR-40	TEMPORARY OFFICE TRAILER
TR-41	TEMPORARY OFFICE TRAILER
TR-46	RSWF OFFICE TRAILER

BUILDINGS

701	SECURITY BUILDING
702	PLANT SERVICES EQUIPMENT STORAGE BLDG.
703	SODIUM STORAGE BUILDING
704	FUEL MANUFACTURING FACILITY (FMF)
706	CONSTRUCTION SHOP/STORAGE BLDG.
707	FIRE PUMP HOUSE
709	FCF SAFETY EQUIPMENT BLDG.
710	ENGINEERING OFFICE BUILDING
713	MODULAR OFFICE BLDG. T-13
714	MODULAR OFFICE BLDG. T-12
716	DOE MODULAR OFFICE BLDG. T-16A
717	MODULAR OFFICE BLDG. T-2
718	MODULAR OFFICE BLDG. T-3
719	S.I. POST T-4
742	GASOLINE/DIESEL DISPENSARY
751	REENTRY BUILDING
752	LABORATORY AND OFFICE BLDG.
752A	DIESEL GENERATOR BUILDING
753	PLANT SERVICES BUILDING
754	WELL PUMP HOUSE No. 1
755	FUEL OIL PUMP HOUSE
756	WELL PUMP HOUSE No. 2
757	COOLING TOWER
757A	MAIN COOLING TOWER ACID SYSTEM BLDG.
758	ELECTRICAL SUBSTATION
759	FIRE HOUSE (EBR-II)
760	SANITARY WASTE PUMP HOUSE
764A	STACK MONITORING
765	FUEL CYCLE FACILITY (FCF)
765A	FCF OFFICE BUILDING
766	SODIUM BOILER PLANT
767	REACTOR PLANT
768	POWER PLANT
768A	POWER PLANT CHANGE ROOM
768B	WATER CHEMISTRY LABORATORY
769	DANGEROUS MATERIALS STORAGE BLDG.
770B	SODIUM COMPONENTS STORAGE BLDG.
770C	NUCLEAR CALIBRATION LABORATORY
772	EBR-II ENGINEERING LABORATORY
778	SANITARY WASTE LIFT STATION
778A	INDUSTRIAL WASTE LIFT STATION
780	LAUNDRY SORTING BUILDING
781	MATERIALS HANDLING BUILDING
782	MACHINE SHOP FACILITY
783	RIGGING TEST FACILITY
785	HOT FUEL EXAMINATION FACILITY (HFEF)
786	HFEF 480V SUBSTATION
787	FUEL ASSEMBLY AND STORAGE BLDG.
788	EBR-II MAINTENANCE SHOP
789	EBR-II ENGINEERING LABORATORY
789A	EQUIPMENT BUILDING
790	INTERIM CONTAMINATED EQUIPMENT STORAGE
791	INSTRUMENT AND MAINTENANCE FACILITY
793	SODIUM COMPONENTS MAINTENANCE SHOP
793C	SCMS CONTAMINATED STORAGE BLDG.
794	CONTAMINATED EQUIPMENT STORAGE FACILITY
795	EBR-II COVER GAS CLEANUP SYSTEM BLDG.
796	METAL STOCK CONTROL BLDG.
798	RADIOACTIVE LIQUID WASTE TREATMENT FACILITY
799	SODIUM PROCESSING FACILITY
	XENON TAG SAMPLING SHELTER
	FLAMMABLE MATERIALS STORAGE BUILDING
	EXPERIMENTAL EQUIPMENT BUILDING
	PLANT SERVICES STORAGE BUILDING

ZERO POWER PHYSICS REACTOR (ZPPR)

774	ZPPR SUPPORT WING
775	ZPPR VAULT-WORKROOM-EQUIPMENT ROOM
776	ZPPR REACTOR CELL
777	ZPPR EQUIPMENT BUILDING
784	ZPPR MATERIALS CONTROL BUILDING
792	ZPPR MOCK-UP BUILDING

FIGURE 2-2

JANUARY 8, 1996/ESWM
SITE-109.DWG (SITE-28)

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6 RISK ASSESSMENT METHODOLOGY

This section is presented as a precursor to the INEL WAG 9 (OU 9-04) comprehensive Remedial Investigation / Baseline Risk Assessment (RI/BRA). The purpose of this section is to present the proposed WAG-9 BRA methodology in order to facilitate discussion and build consensus for development of the WAG-9 RI/BRA. For ease of presentation, the rest of this section is divided into two sections. Section 6.1 describes the OU 9-04 human health risk assessment methodology and Section 6.2 discusses the WAG 9 ecological risk assessment methodology.

6.1 Human Health Risk Assessment

The human health risk assessment approach used in the OU 9-04 BRA will be based on the EPA's *Risk Assessment Guidance for Superfund Volume 1, Human Health Evaluation Manual (Part A)* (EPA, 1989a), the INEL Track 2 Guidance document (DOE, 1994) and the INEL Cumulative Risk Assessment Guidance Protocol (INEL, 1995).

In general, the tasks associated with development of the human health risk assessment can be divided up as follows:

- Data evaluation.
- Exposure assessment.
- Toxicity assessment.
- Risk characterization.
- Uncertainty analysis.

Each of these tasks are described in the following sections.

6.1.1 Data Evaluation

All sampling data collected to date at WAG 9 release sites will be evaluated to determine whether the data is appropriate and adequate for use in the OU 9-04 BRA. This evaluation will be conducted in accordance with EPA's *Guidance for Data Useability in Risk Assessment* (EPA, 1992b) for nonradionuclides and *Guidance for Data Useability in Risk Assessment (Part B)* (EPA, 1992c) for radionuclides.

The data evaluation tasks that will be completed in the BRA are as follows:

- Identify release sites and co-located facilities that require further evaluation.

- Review available sampling data for the retained release sites.
- Identify contaminants detected at each release site and identify the frequency of detection for each contaminant.
- Determine the statistical distribution of each data set.
- Develop each data set for use in the risk assessment.

All data gaps identified by the SDGA are being filled as described in Section 2.3. No further data gaps are expected to be identified in the BRA.

6.1.1.1 Site and Contaminant Screening.

Identification of release sites that will be evaluated in the BRA will be performed using the steps identified in Section 2.1. Next, contaminant screening is performed (Section 2.2). The sites and their associated contaminants retained for the BRA are presented in Table 2-12.

6.1.1.2 ANL-W Co-Located Facility Evaluation.

In addition to evaluation of current release sites, the potential for future releases of hazardous contaminants from ANL-W co-located facilities will be evaluated in the BRA. The co-located facilities evaluation will be performed using the following process:

1. Identify all buildings and structures, including underground storage tanks, that currently exist at ANL-W.
2. Identify applicable safety documentation or other appropriate information, that addresses the potential for future contaminant releases from each building or structure.
3. Identify features that will prevent or mitigate the effects of future releases from facilities that may need additional safety documentation.
4. Condense the information gathered in the above three steps for presentation in tabular form.

If a determination is made that any ANL-W facilities require additional safety documentation or features to address the potential for future releases, the need for this additional documentation will be reported to the appropriate organizations. The BRA development and review will not be delayed while this additional safety documentation is prepared.

6.1.2 Exposure Assessment

Exposure assessments involve the following activities:

- Identification and characterization of exposed populations.
- Estimation of contaminant concentrations at exposure points for each media evaluated (e.g., groundwater, soil).
- Evaluation of exposure pathways (e.g., soil ingestion, fugitive dust inhalation).
- Estimation of contact (i.e., intake) rates for each media.
- Calculating intake.

Each of these activities is described in the following sections.

6.1.2.1 Identification and Characterization of Exposed Populations

The following current human populations could potentially be exposed to contaminants found at, or originating from, WAG 9:

- Workers – Since WAG 9 is currently operational, workers at the site are potential receptors. If complete exposure routes to these site workers are identified, then risks to workers will be evaluated. The following two occupational exposure scenarios will be analyzed in the OU 9-04 BRA:

  1. A current occupational exposure scenario that lasts for 25 years from the present.
  2. A future occupational exposure scenario that starts in 100 years from the present and lasts for 25 years.

This second occupational exposure scenario will only be evaluated if the risks from exposure to radionuclides exceed the lower limit of the NCP target risk range (i.e, 10^{-6}). Nonradionuclides will not be evaluated in the 100-year occupational exposure scenario because no credit will be taken for decay processes; hence, the exposure point concentrations will be the same as for the current occupational exposure scenario.

- Residents – For the purposes of the BRA, residential development will be considered as a potential future use of the site, therefore, future residential use will be quantitatively evaluated. Since the nearest single-family residence is located several miles from the boundary of WAG 9, current residents will not be evaluated in the OU 9-04 BRA.

For the purposes of the BRA, the assumption will be made that future residents will construct 3 m (10 ft) basements beneath their homes. As a result, all contamination detected in the upper 3 m (10 ft) of each release site will be evaluated for surface pathway exposures. This analysis method will hereafter be referred to as a residential intrusion scenario, and all residential exposure scenario analysis in the OU 9-04 BRA will include the residential intrusion exposure scenario.

The following two hypothetical residential exposure scenarios will be evaluated in the OU 9-04 BRA:

1. A future residential exposure scenario that starts in 100 years and lasts for 30 years.
2. A future residential exposure scenario that starts in 1,000 years and lasts for 30 years.

For nonradionuclides, chemical decay processes (e.g., microbial degradation) are not included in the baseline risk assessment. Therefore, the exposure point concentration for all exposure pathways except groundwater ingestion will remain constant for the different time-frames of interest for the residential exposure pathways. Therefore, risks and hazard quotients from exposure to the nonradionuclides will only be recalculated for the groundwater ingestion exposure pathway in the 1,000-year figure residential exposure scenario. All other exposure point concentrations will remain the same for both future residential exposure scenarios and subsequently, so will the risks and hazard quotients for the other exposure pathways. However, for completeness the risks and hazard quotients calculated in the 100-year future residential exposure scenario for all exposure pathways but groundwater ingestion will be presented with the risks and hazard quotients in the 1,000-year future residential exposure scenario.

6.1.2.2 Evaluation of Exposure Pathways

Once potentially exposed populations have been identified and characterized, exposure pathways can be traced from the site to the exposed populations. Each exposure pathway will describe a mechanism by which a human receptor could be exposed to contaminants originating from the site. Only those exposure pathways deemed to be complete (i.e., where a plausible route of exposure can be demonstrated from the site to the receptor), will be quantitatively evaluated in

the BRA. The BRA risk results will be based on estimates of reasonable maximum exposures (RME) to the site's contaminants.

Figure 6-1 and 6-2 show the WAG 9 preliminary conceptual site models (PCSMs) for the retained sites at ANL-W. The PCSM for the Burn Pits which was shown in the WAG 9 Scope of Work is not shown here because, it has been screened out because no data gaps were identified in Section 2 of this Work Plan. The following exposure scenarios, exposure routes and exposure pathways will be evaluated in the OU 9-04 BRA:

Exposure Scenarios:

- Occupational.
- Residential intrusion.

Exposure Routes:

- Ingestion.
- Inhalation.
- Dermal contact.
- External radiation.

Exposure Pathways:

- Inhalation of fugitive dust and volatile organic compounds originating from contaminated soil.
- Soil ingestion.
- External radiation exposure originating from contaminated soil.
- Dermal absorption with both soil (e.g., gardening) and groundwater contact (e.g., showering).
- Inhalation of volatile organic compounds during showering (residential exposure scenario only).
- Ingestion of home grown produce (residential exposure scenario only).
- Groundwater ingestion (residential exposure scenario only).

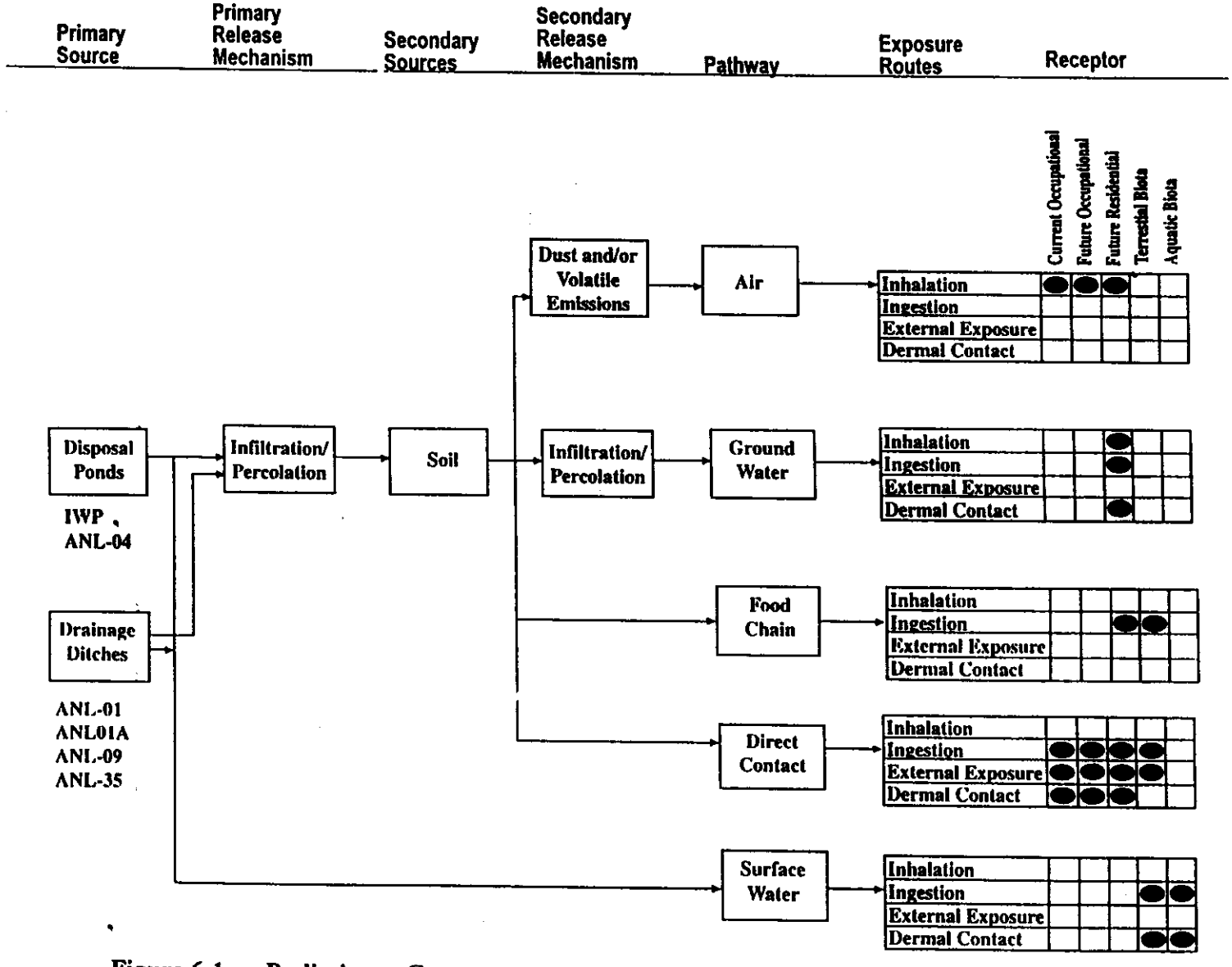

Figure 6-1 Preliminary Conceptual Site Model of Disposal Ponds and Drainage Ditches.

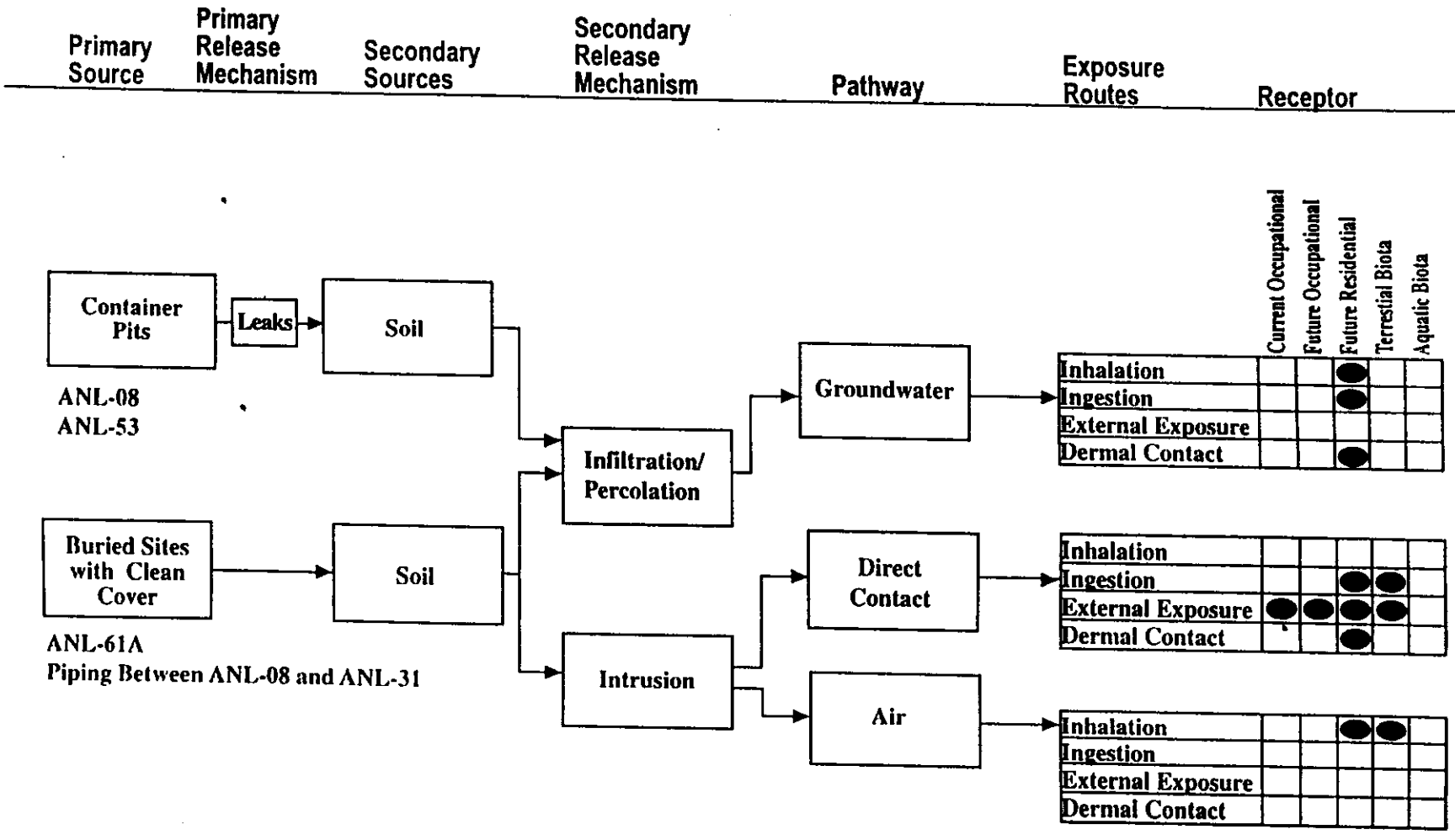

Figure 6-2 Preliminary Conceptual Site Model of Container Pits and Buried Sites with Clean Cover.

6.1.2.3 Extent of Contamination

The aerial extent of contamination is used as the area where the hypothetical receptor is located. The vertical extent of contamination is used to determine the exposure pathways to be evaluated. Where possible, interpolation methods (e.g., inverse distance weighted interpolation) will be used to define the extent of contamination. The interpolation method used will vary upon the quality of available data and the strength of spatial correlations of the contaminant concentrations between sample locations. At sites where the data are limited or no spatial correlation is observed, the site dimensions will be used as the horizontal extent of contamination and the maximum sample depth will be used as the upper limit of the vertical extent of contamination. Detailed site-specific results for the aerial extent of contamination will be presented in the RI.

6.1.2.4 Estimation of Contaminant Concentrations at Exposure Points

Exposure concentrations associated with each contaminant of potential concern (COPC) will be estimated for groundwater, air, food crops and soil. The following sections provide details on how the concentrations for each of these media will be estimated.

The exposure point concentrations for radionuclides will be adjusted for the effects of radioactive decay. This adjustment will be performed by estimating radionuclide concentrations at the start of a given exposure scenario, and then calculating the average concentrations that will exist during the length of the exposure scenario. For example, the concentration of a given radionuclide analyzed in the current occupational exposure scenario will be the average concentration that would exist between 0 and 25 years in the future, and the concentration analyzed in the 100-year future residential scenario will be the average concentration that would exist from 100 to 130 years.

6.1.2.5 Groundwater Transport Methodology

To quantify risks for the future residential receptor (there is no occupational receptor for this exposure pathway), modeling of contaminant concentrations in groundwater will be required. For the groundwater transport analysis, it is assumed that every contaminant that is not screened by the contaminant screening process (described in Section 2.2) could potentially migrate to groundwater. Contaminant concentrations from all retained sites will be combined to produce a cumulative groundwater risk estimate for WAG 9.

In the OU 9-04 BRA, GWSCREEN (Rood, 1994) will be used to estimate future contaminant groundwater concentrations. For each retained contaminant, the model will produce groundwater concentrations versus time as the code's output. From this output, the maximum 30 year average groundwater concentration, and the 30 year average concentration at 100 and 1,000 years in the future, will be calculated for each contaminant. The maximum average concentration will be used to calculate the maximum expected groundwater risk for each contaminant, and the average concentrations at 100 and 1,000 years will be used to calculate risks at the same points in time at which risks for other exposure pathways will be calculated.

The total mass of each contaminant considered in the groundwater pathway analysis will be calculated by summing the contaminant masses from the retained sites. The contaminant mass at each retained site will be derived by multiplying the contaminant's 95% upper confidence level of the mean (UCL) concentration (or maximum concentration if the maximum is less than the UCL) by the mass of contaminated soil at the site. For example, if a contaminant has a UCL concentration of 5 mg/kg at 3 release sites with dimensions of 10 m x 10 m x 1 m (9 ft x 9 ft x 3 ft), the mass of the contaminant that would be used in the GWSCREEN modeling would be 2 .3E+06 mg ([3 sites] x [5 mg/kg/site] x [10 m] x [10 m] x [1 m] x [1E+06 cm^3/m^3] x [1.5 g/cm^3] x [1E-03 kg/g] = 2.3E+06 mg).

Once contaminant masses have been calculated, the area of contamination will be derived. This area will be based on the sum of the surface areas of all retained sites. For example, if only three sites are retained by the site screening process, and each of the retained sites has a surface area of 10 m^2 (108 ft^2), the total area of contamination used in the GWSCREEN modeling would be 30 m^2 (323 ft^2). Considering only the areas of contamination in the GWSCREEN modeling will produce very conservative groundwater concentration estimates because dilution of contaminated groundwater by water that infiltrates through uncontaminated areas of the WAG will be ignored.

The contaminant source thickness for use in GWSCREEN will be the average depth of contamination at the retained sites. This thickness will be derived by dividing the sum of the retained site source volumes by the sum of the retained site surface areas.

In order to make the contamination surface area suitable for use in GWSCREEN, the area will be transformed into an equivalent rectangle, and the sides of the rectangle will be set perpendicular and parallel to the direction of groundwater flow. This transformation is necessary because GWSCREEN requires a rectangular site area. The receptor for groundwater ingestion will be assumed to be located in the center of the equivalent rectangle's downgradient edge.

Values assigned to other parameters used in GWSCREEN are presented in Table 6-1. If the risk from groundwater ingestion for any contaminant is greater than 1E-04 then additional more detailed groundwater modeling may be performed. This additional modeling will use less generic, more site specific parameters for contaminant transport both in the vadose zone and within the aquifer. While this may result in the use of less conservative assumptions it will be more in line with actual conditions at the site.

6.1.2.5.1 Prediction of Future Groundwater Concentrations

For each COPC, the groundwater source term will be used to predict the following groundwater concentrations at the center of the equivalent rectangle's downgradient edge:

- A 30-year average concentration between 100 and 130 years in the future.
- A 30-year average concentration between 1,000 and 1,030 years in the future.
- The maximum 30-year average concentration between 0 and 10,000 years in the future.

Groundwater risks for each residential exposure scenario will be calculated using the 100 and 1,000 year concentrations, and the maximum groundwater risk for each COPC will be calculated using the COPC's maximum 30-year average concentration.

6.1.2.5.2 Groundwater Transport Assumptions

The BRA groundwater pathway analysis will include the following assumptions:

- The total mass of contaminants for all retained sites will be available for transport to the water table.
- Radioactive progeny will not travel with parent radionuclides.
- All contaminants will be uniformly distributed within the groundwater modeling source volume.
- The groundwater pathway receptor will take all drinking water from a well located at the center of the equivalent rectangle's downgradient edge for 30 years.

Table 6-1 GWSCREEN parameter values to be used in the OU 9-04 BRA.

Parameter	Parameter value
Aquifer	
Pore velocity	570 m/yr
Longitudinal dispersivity	9 m
Transverse dispersivity	4 m
Length of well screen (EWST)	15 m
Dry bulk density	1.9 g/mL
Porosity	0.1
K_d	Contaminant specific[a]
Unsaturated zone	
Net infiltration	10 cm/yr
Volumetric water content	0.3
Dry bulk density	1.9 g/mL
Depth to groundwater (depth of interbeds at ANL-W, from Appendix I)	31.24 m based on interbed depth
K_d	Contaminant specific[a]
Source zone	
Soil density	1.5 g/mL
Volumetric water content	0.3
Length of source parallel to flow	To be determined
Width of source perpendicular to flow	To be determined
Thickness of contaminated zone	To be determined
Solubility limit	Contaminant specific
K_d	Contaminant specific[a]
Receptor distance downgradient	To be determined
Receptor distance perpendicular to flow	To be determined
Integration time	30 yr

a. For a given contaminant, the same K_d will be used for the aquifer, unsaturated zone, and soil zones.

6.1.2.6 Air Transport Methodology

All sites that pass the site screening process will be assumed to have a contaminant source that can be released into the air pathway.

Since there is a possibility that contamination from multiple sites can mix together within the air volume above ANL-W, the air pathway will be analyzed in a cumulative manner in the OU 9-04 BRA. In order to perform this cumulative analysis, a WAG-wide average soil concentration will be calculated for each retained contaminant. The concentration of each contaminant in the respirable particulate matter above the WAG will be assumed to be equal to this average soil concentration. Averaging contaminant concentrations over the WAG for the air pathway will produce one contaminant-specific risk estimate for each air pathway exposure route.

The equations discussed below will be used to estimate airborne contaminant concentrations:

$$C_{air} = R \times C_{soil} \times CF \quad (1)$$

where,

C_{air}	=	Contaminant concentration in the air (pCi/m^3 or mg/m^3)
R	=	Airborne respirable particulate matter concentration (μg/m^3) (Mitchell et al. 1995)
C_{soil}	=	WAG average contaminant soil concentration (pCi/g or mg/kg) weighted by site area
CF	=	Conversion factor (10^{-9} kg/ug for nonradionuclides and 10^{-6} g/μg for radionuclides).

and

$$C_{soil} = \frac{\Sigma\, C_n A_n}{A_T} \quad (2)$$

where,

C_n	=	Contaminant soil concentration at site *n* (pCi/g or mg/kg)
A_n	=	Surface area of site *n* (m^2)
A_T	=	Total area of the WAG 9 retained sites (m^2)
n	=	Number of sites.

Equations 1 and 2 do not account for risks due to inhalation of background contaminants that are blown from uncontaminated areas of the WAG.

The equation that will be used for estimating the concentration of airborne volatile organic compounds is:

$$C_{air} = \frac{\Sigma\ (C_n / VF_n)\ A_n}{A_T} \qquad (3)$$

where,

C_n = Contaminant soil concentration at site *n* (mg/kg)
VF_n = Volatilization factor [as described in DOE (1994)] for site *n* (m^3/kg)
A_n = Surface area of site *n* (m^2)
A_T = Total area of the WAG (m^2).

As with the groundwater transport, the receptor for the inhalation of fugitive dust and volatile organic compounds exposure pathways will be either a current occupational worker (who is assumed to be exposed for 25 years) or a hypothetical future resident (who is exposed for 30 years).

6.1.2.6.1 Air Transport Assumptions

The BRA air pathway analysis will include the following assumptions;

- The concentration of each retained contaminant in the respirable particulate matter above the WAG will be equal to each contaminant's WAG-wide average soil concentration
- The airborne concentration of each retained contaminant will be the same at every point inside the WAG boundaries
- The air pathway receptor will be assumed to spend the entire exposure duration (25 years for current occupational workers and 30 years for future residents) working or living within the boundaries of the WAG.

6.1.2.7 Soil Screening Analysis

A soil screening analysis will be performed for each waste site that was retained during the site screening analysis. The following exposure pathways will be evaluated in the soil screening analysis.

- Soil ingestion
- External radiation exposure
- Dermal contact with soil
- Consumption of homegrown food crops (residential exposure scenario only).

Unlike the groundwater and air transport pathways, the soil transport pathway will be evaluated on a site by site basis, since exposures through the soil pathway are not likely to occur from more than one release site at a time. The possible exception to this rule is associated with the external radiation exposure pathway. Retained sites that have radionuclide contamination will be evaluated to determine if radiation produced by one site could affect a receptor located at an

adjacent site. In this analysis, radiation exposure rates will be assumed to decrease with the square of distance from a retained site's boundary.

The ingestion of homegrown produce exposure pathway will include an evaluation of COPC concentrations in plants due to both root uptake and irrigation with contaminated groundwater. At each retained site, the total source concentration for a given COPC will be calculated by summing the COPC UCL concentration (or maximum concentration if the maximum is less than the UCL) with the soil concentration that would result from equilibrium partitioning between soil and groundwater contaminated with the COPC.

For dermal contact, four COPCs will be evaluated quantitatively. These COPCs are arsenic, cadmium, PCBs and dioxins/furans. These COPCs have been shown to be absorbed through the skin at a rate high enough to where this exposure pathway may be higher than soil ingestion[3].

6.1.2.7.1 Soil Screening Analysis Assumptions

The BRA soil screening analysis will include the following assumptions:

- With the exception of the external radiation exposure pathway, soil pathway exposures from multiple release sites will be insignificant.
- The likelihood that a future resident will raise meat and dairy products on a residential lot at WAG 9 will be considered to be negligible. As a result, risks from the ingestion of meat and dairy products will not be quantitatively evaluated in the BRA. The possibility of risks being produced through this exposure pathway will be discussed qualitatively in the BRA uncertainty section.
- A receptor is assumed to be present at each retained site for the full exposure duration (30 years for a residential receptor and 25 years for an occupational receptor).

6.1.2.7.2 Estimation of Contact Rates

Human exposure is expressed in terms of intake. For nonradionuclides, intake is defined as the amount of a contaminant taken into the body per unit of body weight per unit time (i.e., mg/kg-d). For radionuclides, intake is defined as the absorbed dose which is the mean energy imparted by ionizing radiation to matter (e.g., pCi). Contact rates are the amount of a media contacted per unit time or event (e.g., 2 L/d of water ingestion for the groundwater ingestion exposure pathway) and are obtained from EPA (1991).

The magnitude of exposure to a release site's contaminants is influenced by frequency and duration of contact with contaminated media. There are three types of parameters used to estimate intake:

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[3]Personal communication John L. Schaum and Kim Hoang, U.S. EPA Exposure Assessment Methods Branch to Janine Dinan, U. S. EPA Office of Emergency and Remedial Response, December 15, 1993.

- Exposure point concentrations
- Characteristics of the exposed population (e.g., contact rates, frequency and duration of exposure)
- Averaging time (for nonradionuclides only).

Concentrations used in the OU 9-04 BRA intake calculations will be based on the UCL of the arithmetic mean of the concentrations detected at the site or the maximum detected concentration, whichever is less. Guidance that discusses the appropriate contaminant concentrations to use in risk assessment is provided by the EPA (1989a and 1992d). Intake parameter values used in the BRA will be consistent with these guidance documents.

6.1.2.7.3 Calculating Intake

The equation that will be used to calculate intake for the nonradionuclides in the OU 9-04 BRA for the different exposure pathways is:

$$Intake = \frac{C \times CR \times EF \times ED}{BW \times AT} \quad (4)$$

where,

Intake	=	Contaminant intake (mg/kg-d)
C	=	Concentration of a given contaminant (media specific):
		Soil and food (mg/kg)
		Air (mg/m^3)
		Water (mg/L)
CR	=	Contact rate (media specific):
		Soil and food (g/d)
		Air (m^3/d)
		Water (L/d)
EF	=	Exposure frequency (d/yr)
ED	=	Exposure duration (yr)
BW	=	Body weight (kg)
AT	=	Averaging time (yr).

The above equation applies to all exposure pathways for nonradionuclides. For radionuclides, the following equation will be used to calculate intake:

$$Intake = C \times CR \times EF \times ED \times CF \quad (5)$$

where,

Intake	=	Contaminant intake (pCi or pCi-yr/g)
C	=	Concentration of a given contaminant (media specific):
		Soil and food (pCi/g)

		Air (pCi/m^3)
		Water (pCi/L)
CR	=	Contact rate (media specific):
		Soil and food (g/d)
		Air (m^3/d)
		Water (L/d)
EF	=	Exposure frequency (d/yr)
ED	=	Exposure duration (yr)
CF	=	Conversion factor (for the external exposure pathway only) (1.14E-04 yr/hr).

6.1.3 Toxicity Assessment

Toxicity assessment is the process of characterizing the relationship between the dose or intake of a substance and the incidence of an adverse effect in the exposed population. Toxicity assessments evaluate results from studies with laboratory animals or from human epidemiological studies. These evaluations are used to extrapolate from high levels of exposure, where adverse effects are known to occur, to low levels of environmental exposures, where effects can only be predicted based on statistical probabilities. The results of these extrapolations are used to establish quantitative indicators of toxicity.

Toxic effects are divided into two classes for purposes of establishing quantitative indicators of toxicity: noncarcinogenic and carcinogenic. Toxicity values are obtained through EPA-developed reference doses (RfD) or reference concentrations (RfC) for noncarcinogens or slope factors (SF) for carcinogens. Health-based toxicity values are assumed to be available for all OU 9-04 contaminants.

The BRA will include a toxicological profile for each contaminant. These profiles will discuss:

- Chronic toxic effects of these chemicals in humans.
- Maximum contamination levels (MCLs) and other health-protective criteria.

Toxicity profiles also consider the nature and weight of evidence supporting the dose-response curve and classification of carcinogenicity, as well as the magnitude of uncertainty surrounding the dose-response. Toxic effects for both carcinogens and noncarcinogens are presented in the following sections.

6.1.3.1 Toxicity Values for Noncarcinogens

In accordance with EPA guidance, the preferred numerical indicators of toxicity will be EPA-derived RfDs. Reference doses for contaminants considered in the BRA will be obtained from the EPA's Integrated Risk Information System (IRIS) database (EPA, 1996) or the *Health Effects Assessment Summary Tables* (EPA, 1995a and 1995b). Reference doses are based on the assumption that thresholds exist for certain noncancerous toxic effects (e.g., cellular necrosis). The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily

exposure that may occur without a significant risk of producing adverse health effects during a lifetime of exposure.

6.1.3.2 Toxicity Values for Carcinogens

Evidence of carcinogenicity of a contaminant comes from two sources: life-time studies with laboratory animals and human studies where excess cancer risk is associated with exposure to a given contaminant. Unless evidence to the contrary exists, a carcinogenic response is assumed to occur at all lower exposure levels if a carcinogenic response occurs at the level administered during a given study. Exposure to any level of a carcinogen is therefore considered to have a possibility of inducing cancer (i.e., zero possibility of contracting cancer is only associated with zero exposure to a carcinogen).

Because the dose-response of carcinogens at low levels of exposure cannot be quantified directly from either animal or epidemiological studies, mathematical models are used to extrapolate from high to low doses. The linearized multi-stage model procedure for low-dose extrapolation is recommended by the EPA (EPA, 1989a). Use of the linearized multi-stage model leads to a plausible upper-bound estimate of risk. The model incorporates procedures for estimating the largest possible slope at low doses that is consistent with the experimental dose-response data (use of a large slope tends to produce a higher estimate of cancer risk). The animal data used for extrapolation are taken from the most sensitive species studied, based on the assumption that man is at least as sensitive as the most sensitive animal species. The dose-response estimates made with this model should be regarded as health-protective, representing the most plausible upper limit of the dose-response curve.

Numerical estimates of cancer potency are presented in IRIS (EPA 1996) for nonradionuclides and in HEAST (EPA, 1995a and 1995b) for radionuclides as slope factors. In addition, slope factors for some nonradionuclides may be presented in the HEAST (EPA 1995a and 1995b). Under the assumption of dose-response linearity at low doses, the SF defines the carcinogenic dose-response from continuous life-time exposure to one unit of carcinogen (in units of risk per mg/kg-day).

Numerical estimates of cancer potency are presented IRIS (EPA, 1996) as slope factors and will be obtained from the HEAST (EPA, 1995a and 1995B), as slope factors. Under the assumption of dose-response linearity at low doses, the SF defines the carcinogenic dose-response from continuous life-time exposure to one unit of carcinogen (in units of risk per mg/kg-day).

6.1.4 Risk Characterization

The characterization of risk combines the results of the toxicity and exposure assessments to provide a numerical estimate of health risk. This estimate is a comparison of intake with appropriate toxicity values, or an estimate of the lifetime cancer risk associated with a particular intake.

The following equation is used to obtain numerical estimates of lifetime cancer risks:

$$Risk = Intake \times SF \quad (6)$$

where,

Risk	=	Potential cancer risk adjusted for lifetime exposure (unitless)
Intake	=	Contaminant intake (pCi or mg/kg-day)
SF	=	Carcinogenic slope factor [$(pCi)^{-1}$ or $(mg/kg\text{-}day)^{-1}$]

To obtain an estimate of total risk from all carcinogens, cancer risks will be summed across all exposure pathways identified in the risk assessment. However, risks from radionuclides and nonradionuclides will not be summed (EPA, 1989a). Carcinogenic risks will be compared to the National Oil and Hazardous Substances Pollution Contingency Plan's target risk range (i.e., 10^{-6} to 10^{-4}).

To determine the adverse health effects from exposure to noncarcinogens a hazard quotient is calculated for each contaminant. The hazard quotient is the ratio of the intake rate to the RfD, as:

$$HQ = \frac{Intake}{RfD} \quad (7)$$

where,

HQ	=	Hazard Quotient (unitless)
Intake	=	Contaminant intake (mg/kg-day)
RfD	=	Reference Dose (mg/kg-day).

For those nonradionuclides that have a RfC for the inhalation exposure pathway, the hazard quotient is defined as:

$$HQ = \frac{Intake}{RfC} \quad (8)$$

where,

Intake	=	Contaminant intake (mg/m^3)
RfC	=	Reference concentration (mg/m^3).

Hazard quotients will also be summed across exposure pathways to calculate a hazard index (HI) for each contaminant. If the HQ or HI exceeds one, there may be concern for the potential noncarcinogenic effects because the intake exceeds the acceptable concentration. If the HQ or HI is less than one, the soil concentration of the metal is presumably below the threshold of

potential noncarcinogenic effects, and no adverse health effects are expected from exposure to the metal.

The BRA risk results will be presented in both tabular and graphical forms. The tabular form will list numerical risk results for each retained site, and the graphical form will be presented on maps that show all of the WAG 9 release sites (one map will be developed for each analysis time period). In the graphical presentation, a small bar graph that shows the risks for each exposure route will be drawn next to each retained site. Since the inhalation of fugitive dust and volatile organic compounds and ingestion of groundwater exposure pathways will be analyzed in a cumulative manner, the risks for these two exposure pathways will be the same for multiple release sites. Conversely, risks for the soil pathway exposure pathways will be calculated for each retained site, so the soil pathway risks will vary on a site by site basis. The risk result maps will be formatted in the same way as the maps contained in the SDGA.

When health-based toxicity values are not available, the risk characterization will be a comparison of the exposure point concentration in the different affected media to regulatory standards (e.g., MCLs in groundwater). In addition, the qualitative evaluation of COPCs presented in the uncertainty section will be performed.

6.1.5 Uncertainty Analysis

The characterization of uncertainty is an important component of the BRA process. According to EPA's Guidance on Risk Characterization for Risk Managers and Risk Assessors, point estimates of risk "do not fully convey the range of information considered and used in developing the assessment." To provide information about the uncertainties associated with the RME estimate, a qualitative or semi-quantitative uncertainty analysis will be performed in the OU 9-04 BRA. The uncertainty analysis will examine the components of the BRA and will assess the effect of the uncertainty involved with each component by discussing whether the uncertainty could produce an overestimation or an underestimation of risk. The results of this qualitative uncertainty analysis will be presented in tabular form. Additionally, the results of the co-located facility assessment (see Section 5) will be presented in the uncertainty analysis section.

6.2 Ecological Risk Assessment

An ecological risk assessment is the evaluation of the likelihood that undesirable ecological effects may occur, or are occurring, as a result of exposure to one or more stressors (where "stressor" refers to any physical, chemical, or biological entity that can induce an adverse effect) (EPA, 1992a).

The general goals of a baseline ERA are to:

- Contribute to ecological remediation of release sites by providing information which will aid in the remedial decision-making process.

- Inform risk managers and the public of the magnitude and significance of ecological risk at evaluated release sites.

- Enhance the credibility of the entire BRA by ensuring that nonhuman receptors are protected from potential adverse effects at the release sites.

To address the unique circumstances at the INEL, a phased approach to ERA is used. The approach applies an iterative, "tiered" process in which preliminary assessments, based on conservative assumptions, support progressively more refined assessments (Maughn, 1993; Opresko et al., 1994; Levin et al., 1989). The first phase is the screening level ERA, which is a "preassessment" performed at the WAG level. The screening level ERA (SLERA) is performed to reduce the number of sites and contaminants to be addressed in subsequent assessment (SLERA included in the WAG Work Plan). The second phase is the performance of an WAG interim ERA. The WAG interim ERA utilizes the screening level ERA results and assesses potential risks to ecological receptors using an approach that parallels the human health risk assessment methodology for addressing risk to ecological receptors at the WAG level. The results of the WAG ERA provide information to support the third phase, a site-wide baseline ERA. The site-wide ERA will integrate WAG results to evaluate risks to INEL-wide ecological resources.

The WAG ERA applies aspects of the methodologies developed for screening level ERA (VanHorn et al., 1995) and will incorporate the results of the screening level ERA. The WAG ERA, however, also duplicates the approach developed for the cumulative human health risk assessments by providing a site-by-site assessment of those contaminants that were not eliminated in the screening level ERA. The general goals of the WAG ERA are to:

- Define the extent of contamination for each site at the WAG level
- Determine the actual or potential effects from contaminants on protected wildlife species, habitats or special environments at the WAG level
- Document the actual or potential adverse ecological effects to ecological receptors from contaminants at each site within a WAG.

In general, the tasks associated with development of the OU 9-04 WERA assessment can be divided up as follows:

- Problem formulation.
- Site and contaminant screening.
- Risk analysis for the retained sites and contaminants.
- Risk characterization.

Each of these tasks are described in the following sections.

6.2.1 Problem Formulation

Problem formulation is the essential scoping component in the ERA process. The main feature of problem formulation is a preliminary evaluation consisting of the identification of relevant policy goals, a description of target ecosystems and their components and identification of potential stressors, pathways and ecological effects. The preliminary evaluation leads to selection of ecological endpoints that are appropriate for the site.

The activities performed in the problem formulation are highly interactive and interrelated. The problem formulation directs the level of detail and information that will be needed to complete the assessment and ultimately results in a conceptual site model that describes how a given stressor might affect the ecological components in the environment (VanHorn et al., 1995).

6.2.2 Site and Contaminant Screening

The WERA site screening will include the following steps:

- Eliminate sites that are unaccessible to the ecosystems of concern (no pathway to the environment)
- Eliminate sites that have no contaminants (no source).

Once the site screening process is complete, the following contaminant screening process will be performed:

1. Eliminate from the risk evaluation all contaminants with zero detects.
2. Eliminate contaminants based on a comparison with background data developed by Rood et al. (1995) and other related background values. Contaminants that exceed the INEL site-specific background levels at a frequency of 5 percent or less or have maximum concentrations less than the 95 percent UTL for background data will be eliminated.
3. Eliminate contaminants that have both a detection frequency of less than 5 percent and no evidence that the contaminant was released at the site. As a precautionary measure, if a COPC has the potential to be eliminated by this step, an evaluation of the detected concentrations will be performed to ensure that a contaminant hot spot will not be overlooked.
4. Eliminate contaminants based on comparison with toxicological data, number of samples, or other criteria with documented rationale.

All sites and contaminants remaining after screening will be evaluated in the ERA.

6.2.3 Risk Analysis

The analysis component of ERA involves the technical evaluation of exposure and effects. Analysis of exposure and effects is based on the ecological endpoints and conceptual model derived during the problem formulation component.

The following general procedures are used:

- Exposure analysis: analysis of factors affecting bioavailability, uptake and pharmacokinetics of contaminants.
- Exposure profile: quantification of exposure point concentrations or doses.
- Compile toxicity criteria for each functional group or sensitive species/COPC pair to generate threshold reference values (TRVs).
- Estimate dose to relevant ecological receptors.

The sources of COPC data for the exposure assessment include the results of direct sampling efforts and the results of fate and transport modeling.

6.2.4 Risk Characterization

The risk characterization component of ERA involves an integration of the results of the analysis phase for the following purposes:

- Identify risks by calculating hazard level quotients (HQs). An HQ is the ratio of a COPC concentration to the TRV and is considered an indicator of risk.
- Evaluate the uncertainties of the ERA
- Summarize and describe the significance of the risks.

The main steps of risk characterization are risk estimation and risk description. Risk estimation integrates the exposure and stressor-response profiles developed in the analysis phase and identifies and quantifies the uncertainties in the ERA. The risk characterization section presents the results of the assessment as input to the risk management process.

7 FIELD SAMPLING PLAN

In 1996, ANL-W will install one additional monitoring well, directly down gradient of the initial release area of the Main Cooling Tower Blowdown Ditch (MCTBD) and drill a corehole in the vadose zone below the EBR-II Leach Pit. The monitoring well will be installed in accordance to the Standard Operating Procedure for Drilling and Installation of Monitoring Wells (LITCO ER&WM SOP-11.6, 3/9/94). The pump testing and initial sample collection from the well will be analyzed in accordance to the list of sampling parameters for four quarters, for one year as stated in the WAG 9 Groundwater Monitoring Plan (Appendix D). The samples from the monitoring well will not be mentioned in this SAP because they are covered in the WAG-9 Groundwater Monitoring Plan. The corehole samples from the interbeds below the Leach Pit will be collected and analyzed in accordance with the *WAG 9 Quality Assurance Project Plan for Argonne National Laboratory-West,* dated October 6, 1994.

This Field Sampling Plan (FSP) is one half of the required documentation of a Sampling and Analysis Plan, as specified in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCL* (EPA, 1988). The other half of the required documentation is the Quality Assurance Project Plan (QAPjP). This QAPjP can be found in Appendix E of the WAG 9 Sampling and Analysis Plan for Operable Units 9-01, 9-03 and 9-04 which is in the Administrative Record. The FSP describes in detail the history of the sites being sampled and the proposed sampling methods, contaminants of concern, anticipated sampling locations and the number and type of data quality control samples needed.

7.1 Leach Pit Site Background

The EBR-II Leach Pit is located between the inner and outer security fences in the southwest corner of the ANL-W facility. The pit is an irregularly shaped, unlined underground basin approximately 5.5 m (18 ft) wide by 12 m (40 ft) long; the bottom of the Leach Pit is 4.6 m (15 ft) below ground surface. The Leach Pit was excavated into basalt bedrock in 1959 with explosives. A 20 cm (8 in.) thick, reinforced-concrete slab lid was installed 1.5 m (5 ft) below land surface and covered with native soil to prevent ingress of wildlife and precipitation.

Initially, the pit received all of the liquid industrial waste, including cooling tower blowdown, sanitary effluent, cooling condensates and radioactive effluent, generated at the ANL-W facilities. Discharge of industrial waste ceased following construction of the industrial waste pond in 1962. Sanitary-waste discharge to the Leach Pit ceased when ANL-W completed the sanitary lagoons in 1965. Although the radioactive liquid-evaporation system was completed in 1971[4], ANL-W used the Leach Pit for subsurface release of low-level radioactive effluent until 1973. The average annual discharge to the Leach Pit was approximately 9×10^4 gallons from 1960 to October 1973, containing a total of 10.4 curies of radioactivity (LATA, 1990a).

[4]Stewart, N., 1993, Argonne National Laboratory-West, Personal Communication with D. J. Haley, November 16.

According to Volume II of the *Monitoring, Analysis, and Test (MAT) Plan* (LATA, 1990b) the Laboratory and Office (L&O) building was the primary generator and collection point for liquid waste suspected of containing radioactive constituents. The majority of the wastes were produced in the L&O building chemistry laboratories, the Hot Fuels Examination Facility-North and the Hot Fuels Examination Facility-South (HFEF-S). The Fuel Assembly and Storage Facility, the HFEF-S truck lock, the Building 768 change room, the component cleanup facility and the Zero Power Physics Reactor generated minor amounts of liquid radioactive waste and transferred those wastes to a receiving tank in the L&O building via a tanker truck; those wastes were ultimately discharged to the Leach Pit.

There are no records to indicate the types or quantities of nonradioactive contaminants that may have been discharged to the Leach Pit prior to startup of the industrial waste pond (LATA, 1990b). However, because the laboratory and office building chemical laboratories were the primary contributor of waste, it is assumed that organic chemicals, solvents and metal-bearing wastes were discharged to the Leach Pit.

The pit was only used once since 1973. In November, 1975, tritiated water that exceeded the Energy Research and Development Administration (ERDA, now the Department of Energy) standards governing discharge to an uncontrolled area was discharged to the pit. Following that discharge, the pit was isolated from the liquid waste processing system by cutting the line at building 762 (LATA, 1990a and ANL-W, 1990a).

In 1991, as part of a Track 2 investigation soil samples were collected from the leach pit, the interbeds below the leach pit and surface locations in the leach pit and a groundwater sample was collected from a well drilled down gradient from the leach pit. The groundwater and soil samples were analyzed for Volatile organics, Semivolatile organic compounds, Metals, radionuclides, anions and pH. The results indicate the sludge samples in the leach pit and the soil samples collected below the leach pit in the interbeds had contamination. The sludge results indicated that the cadmium concentrations exceeded the TCLP limit for a hazardous waste. Groundwater concentrations of radionuclides exceed the risk based levels but are less than the drinking water Maximum Contaminant Levels (MCLs). Also, a Track 2-type risk assessment was performed which indicated that OCDD detected in the groundwater presents a potential risk of 1E-06, or at the lower limit of the NCP target risk range. Three samples were collected below the Leach Pit. These three samples were identified as C1, C2 and C3. Core samples C1 and C2 were collected using a California splitspoon sampler with lexan liners. Samples C1 and C2 were collected at the northeast and southwest edges of the Leach Pit to determine if lateral migration had occurred and C3 was collected near the center of the Leach Pit to determine the vertical migration of the contaminants (See Figure in Appendix B). Soil samples C1 and C2 were collected at the alluvium/basalt interface 20 feet below ground surface (BGS). Sample C3 was collected by drilling through the basalt below the Leach Pit to the first interbed 36 feet BGS. Drilling continued in C3 to a depth of 60.6 feet without encountering any additional interbeds. The three soil samples were analyzed for Appendix VIII analysis for soils, which includes Alcohols, Volatile Organics, Semivolatile Organics, Pesticide/PCBs, Phosphate Pesticides, Chlorinated Herbicides, Dioxin/Furans and Metals, along with Cyanide/Sulfate, TCLP metals and Radionuclide analysis. The results of these samples are shown in Appendix A of this Work Plan and indicate that the vadose zone has exceeded the INEL upper 95% tolerance limits with 95%

confidence for background grab samples for the following contaminants; OCDD (2/3), antimony (3/3), arsenic (1/3), cadmium (3/3), calcium (2/3), mercury (3/3), silver (1/3), sodium (1/3), thallium (3/3), Am-241 (3/3), Cs-137 (1/3) and Sr-90 (1/3).

Based on the results of the 1991 investigation, the overburden and lid were removed in the fall of 1993 as part of a removal action conducted under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended. The majority of the sludge was removed in December 1993, the bottom of the Leach Pit was lined with 5 to 7 cm (2–3 in.) of bentonite clay and backfilled to grade. Six samples were collected from the basalt and sent in for analysis. A risk evaluation performed on the concentration of the COPCs in the basalt and in the remaining sludge indicates that the total potential risk is 6E-06 from ingestion of groundwater contaminated with beryllium and Np-237, which is at the lower limit of the NCP target risk range (i.e., 10^{-6}) (RUST Geotech, 1994f).

Based on the results of the 1991 sludge sampling prior to removal, samples of the interbeds, and the groundwater in the down gradient well along with the 1993 verification samples of the basalt after the removal action, a number of uncertainties exist for this site. First, only one sample was collected below the Leach Pit of the first interbed 36 feet BGS. Second, most of the sludge in the Leach Pit was removed and only the remaining 1/16-th of an inch was used in the GWSCREEN runs for the risk assessment calculations. Third, risk assessment calculations were not performed for contaminants that were previously found in the vadose zone. Fourth, the risk assessment calculations were based on the six 1993 verification samples of the basalt after sludge removal not of the interbed material. Since the physical characteristics of the basalt are different than the interbeds, the basalt would retain lower concentrations of contaminants than those of the interbeds.

7.2 Leach Pit Vadose Zone Currently Existing Data Gaps

A Track 2 Summary Report was completed and signed by the Remedial Project Managers (RPMs) in May of 1996, which agrees that no further action is needed for the physical geometric dimensions of the Leach Pit itself (i.e., the length, width and depth of the Leach Pit), but recommended further evaluation of the potential risks posed by the contaminants in the vadose zone beneath the pit in the RI/FS. This SAP will evaluate the results of the previous sampling efforts in 1991 and 1993 and specify additional sampling needed to fill the vadose zone data gap.

7.3 Leach Pit Vadose Zone Contaminants of Concern

A list of the preliminary identified contaminants of concern (COC) for the Leach Pit were listed in Table 2-1 of the Work Plan and are shown in Table 7-1. These preliminary COCs include the results of the vadose zone sampling along with the sludge samples that were collected. The sludge was removed from the Leach Pit in 1993 but the COCs are retained as precautionary measures. The COCs were screened first by comparison to INEL Background 95% tolerance limits with 95% confidence values and then by frequency of accedence and detection. The COCs

Table 7-1 Contaminant screening process for OU 9-02, ANL-08, EBR-II Leach Pit.

	Step 1		Step 2			
Contaminant	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
1,1,1-Trichloroethane[d]	0.004	—[e]	1/1 (100%)	1/1 (100%)	N	NA
Acetone	1.1	—	2/6 (33%)	2/6 (33%)	N	NA
Aluminum	15,036.72	24,000	0/7 (0)%	7/7 (100%)	Y	1
Anthracene	0.11	—	1/6 (17%)	1/6 (17%)	N	NA
Antimony	37.09	7.4	7/7 (100%)	7/7 (100%)	N	NA
Aroclor-1254	6.1	—	3/6 (50%)	3/6 (50%)	N	NA
Aroclor-1260	1.8	—	3/6 (50%)	3/6 (50%)	N	NA
Arsenic	52.8	7.4	4/7 (57%)	7/7 (100%)	N	NA
Barium	255.2	440	0/7 (0%)	7/7 (100%)	Y	1
Benzo(a)anthracene	0.48	—	1/6 (17%)	1/6 (17%)	N	NA
Benzo(k)fluoranthene	0.45	—	1/6 (17%)	1/6 (17%)	N	NA
Beryllium	770.05	3.0	2/7 (29%)	7/7 (100%)	N	NA
Bis(2-ethylhexyl)phthalate	5.3	—	1/1 (100%)	1/1 (100%)	N	NA
Butylbenzlphthalate	0.051	—	1/6 (17%)	1/6 (17%)	N	NA
Cadmium	49.78	3.7	7/7 (100%)	7/7 (100%)	N	NA
Calcium	194,075.47	39,000	3/7 (43%)	7/7 (100%)	Y[g]	3
Chromium	4,305.33	50	4/7 (57%)	7/7 (100%)	N	NA
Chrysene	0.63	—	1/6 (17%)	1/6 (17%)	N	NA

Table 7-1 (continued).

Contaminant	Step 1 Maximum detected concentration (mg/kg or pCi/g)	Step 1 Background screening concentration[a] (mg/kg or pCi/g)	Step 2 Frequency of exceedance[b]	Step 2 Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Cobalt	12.55	18	0/7(0%)	7/7 (100%)	Y	1
Copper	18,839.4	32	4/7 (57%)	7/7 (100%)	N	NA
Cyanide	34.32	—	7/7 (100%)	7/7 (100%)	N	NA
di-n-butylphthalate	2	—	2/6 (33%)	2/6 (33%)	N	NA
Fluoranthene	0.170	—	1/5 (20%)	1/5 (20%)	N	NA
HpCDD	1.04E-04	—	3/6 (50%)	3/6 (50%)	N	NA
HpCDF	1.52E-05	—	3/6 (50%)	3/6 (50%)	N	NA
HxCDD	7.64E-05	—	3/6 (50%)	3/6 (50%)	N	NA
HxCDF	1.50E-05	—	3/6 (50%)	3/6 (50%)	N	NA
Iron	32,243.72	35,000	0/7 (0%)	7/7 (100%)	Y	1
Lead	287.98	23	4/7 (57%)	7/7 (100%)	N	NA
Magnesium	15,124.14	19,000	0/7 (0%)	7/7 (100%)	Y	1
Manganese	352.61	700	0/7 (0%)	7/7 (100%)	Y	1
Mercury	496.6	0.074	5/6 (83%)	5/6 (83%)	N	NA
Methylene chloride	ND	—	0/5 (0%)	0/5 (0%)	Y	1
Naphthalene	0.089	—	1/1 (100%)	1/1 (100%)	N	NA
Nickel	75.24	55	1/7 (14%)	7/7 (100%)	N	NA
OCDD	4.19E-04	—	5/6 (83%)	5/6 (83%)	N	NA

Table 7-1 (continued).

Contaminant	Step 1		Step 2			
	Maximum detected concentration (mg/kg or pCi/g)	Background screening concentration[a] (mg/kg or pCi/g)	Frequency of exceedance[b]	Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
OCDF	7.20E-06	—	3/6 (50%)	3/6 (50%)	N	NA
PeCDD	5.60E-06	—	1/6 (17%)	1/6 (17%)	N	NA
PeCDF	2.60E-06	—	3/6 (50%)	3/6 (50%)	N	NA
Phenanthrene	0.340	—	1/6 (17%)	1/6 (17%)	N	NA
Potassium	2,298.52	6,300	0/6 (0%)	6/6 (100%)	Y	1
Pyrene	0.670	—	1/6 (17%)	1/6 (17%)	N	NA
Selenium	0.15	0.34	0/7 (0%)	1/7 (14%)	Y	1
Silver	22.63	—	5/7 (71%)	5/7 (71%)	N	NA
Sodium	1,047.99	520	3/7 (43%)	7/7 (100%)	Y[g]	3
Sulfate	82.2	—	5/6 (83%)	5/6 (83%)	N	NA
TCDD	2.20E-07	—	1/6 (17%)	1/6 (17%)	N	NA
TCDF	6.50E-07	—	2/6 (33%)	2/6 (33%)	N	NA
Thallium	22.4	0.68	7/7 (100%)	7/7 (100%)	N	NA
Vanadium	50.9	70	0/7 (0%)	7/7 (100%)	Y	1
Zinc	3,016.8	220	4/7 (57%)	7/7 (100%)	N	NA
Am-241	0.65	0.019	3/7 (43%)	3/7 (43%)	N	NA
Ce-144	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Co-58	ND	—	0/7 (0%)	0/7 (0%)	Y	1

Table 7-1 (continued).

Contaminant	Step 1: Maximum detected concentration (mg/kg or pCi/g)	Step 1: Background screening concentration[a] (mg/kg or pCi/g)	Step 2: Frequency of exceedance[b]	Step 2: Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)
Co-60	209	—	4/6 (67%)	4/6 (67%)	N	NA
Cs-134	1.8	—	2/7 (29%)	2/7 (29%)	N	NA
Cs-137	29,110	1.28	5/7 (71%)	6/7 (86%)	N	NA
I-129	124	—	1/7 (14%)	1/7 (14%)	N	NA
Np-237	329	—	6/7 (86%)	6/7 (86%)	N	NA
Pu-238	0.44	0.0091	2/7 (29%)	2/7 (29%)	N	NA
Pu-239/240	3.55	0.19	2/7 (29%)	2/7 (29%)	N	NA
Ru-103	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Ru-106	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Sb-125	ND	—	0/7 (0%)	0/7 (0%)	Y	1
Sr-90	2,247	0.76	4/7 (57%)	6/7 (86%)	N	NA
U-234	35.64	1.95	4/7 (57%)	7/7 (100%)	N	NA
U-235	2.18	—	4/7 (57%)	4/7 (57%)	N	NA
U-238	3.54	1.85	2/7 (29%)	7/7 (100%)	N	NA

Table 7-1 (continued).

Contaminant	Step 1: Maximum detected concentration (mg/kg or pCi/g)	Step 1: Background screening concentration[a] (mg/kg or pCi/g)	Step 1: Frequency of exceedance[b]	Step 2: Frequency of detection[c]	Contaminant eliminated? (Y/N)	Justification for elimination (step number)

a. Obtained from Rood et al., (1995).

b. Expressed as number of detections above background/total number of samples analyzed and as a percent.

c. Expressed as number of detections/total numbers of samples analyzed and as a percent.

d. Only those organic compounds detected are presented. A complete listing of all the analytical results is presented in Appendix A.

e. No background concentration is available. Therefore, any detection is considered to exceed background.

f. Not detected. All contaminants with a "U" or "R" data quality flag are omitted.

g. Maximum detected concentration is less than 10 times the background concentration; therefore the contaminant is eliminated.

are then further screened by eliminating no source and no risk sites (see Section 2.1). Table 7-2 shows the list of COCs for the Leach Pit which have been retained and will need to be assessed in order to fill the data gap.

Table 7-2 Summary of the Leach Pit COPCs, and potential data gaps.

Contaminant Family	COPCs	Contaminated Media	Potential data gaps
Metals	Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Tl, Zn, cyanide, sulfate	Subsurface soil	Yes
Radiological	Am-241, Co-60, Cs-134, Cs-137, I-129, Np-237, Pu-238, Pu-239/240, Sr-90, U-234, U-235, and U-238	Subsurface soil	Yes
Pesticides	Aroclor-1254, Aroclor-1260	Subsurface soil	Yes
Dioxin/Furans	HpCDD, HpCDF, HxCDD, HxCDF, OCDD, OCDF, PeCDD, PeCDF, TCDD, TCDF	Subsurface soil	Yes
Volatile Organics	1,1,1-TCA, acetone	Subsurface soil	Yes
Semivolatile Organics	anthracene, benzo(a)anthracene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, chrysene, di-n-butylphthalate, fluoranthene, naphthalene, phenanthrene, pyrene	Subsurface soil	Yes

7.4 Leach Pit Conceptual Site Model

The Conceptual Site Model (CSM) provides a graphical illustration of the potential sources of contamination, release mechanisms, exposure routes and receptors. The only viable pathway for receptors from the Leach Pit is via the Groundwater Ingestion Pathway, because the residual contamination is below the bottom of the Leach Pit which is 15 feet BGS. Figure 7-1 shows the CSM for the vadose zone below the EBR-II Leach Pit.

7.5 Leach Pit Vadose Zone Data Uses

Data for this investigation fall into two general purpose categories and will be used in the following ways:

- Site characterization data will supplement existing vadose zone data so that the vertical extent of contamination can be better defined. The current existing data gaps identified by ANL-W are listed in Section 2.6.3 of the Work Plan and will be addressed through this additional sampling.

- Data from the vadose zone will be combined with the previous data and used in the baseline risk assessment. The data collected through this characterization effort will only be used to determine the risks associated with the Groundwater Ingestion Pathway, the only viable pathway from the contaminants in the vadose zone below the Leach Pit.

The potential consequence of incorrectly determining that the site does not pose a risk is that potential contamination may remain at concentrations which present an unacceptable risk to human health and the environment. The concern with erroneously determining that the site does pose a risk, is the unnecessary expenditure of funds that could be better utilized at another site.

7.6 Leach Pit Vadose Zone Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements specified to ensure that data of known and appropriate quality are obtained to support decisions regarding remedial response actions. The specific objective for the investigation of the vadose zone below the Leach Pit is to:

- Characterize the vertical extent of the contamination in the vadose zone below the Leach Pit. These values will be used as the source term for the risk assessment calculations.

- Collect samples of the basalt and interbeds directly below the Leach Pit and analyze them for physical properties. These physical properties of this material will enable ANL-W to calculate more realistic modeling of contaminants based on actual site conditions using the GWSCREEN bounding scenario modeling program.

- To collect data of adequate type and quality so the analytical results will meet the needs of the risk assessors.

7.6.1 Leach Pit Vadose Zone Data Needs

Based on the COCs identified in Table 7-2, ANL-W has determined that the interbed samples from the vadose zone will be analyzed for the 23 Contract Laboratory Program (CLP) Target Analyte List (TAL) of; Volatile Organics, Semivolatile Organics, Pesticide Organics, Metals and radionuclides as found in Tables 1, 2, 3, 4 and 5 of Attachment A of the *WAG 9 Quality Assurance Project Plan for Argonne National Laboratory-West*. In addition the Dioxin/Furans will also be analyzed as per the CLP procedure. ANL-W will be using the identified CLP methods in order to meet these EPA risk based concentrations. Depending on interferences encountered during analysis, the actual detection limits may vary from the contract required detection limits (CRDLs).

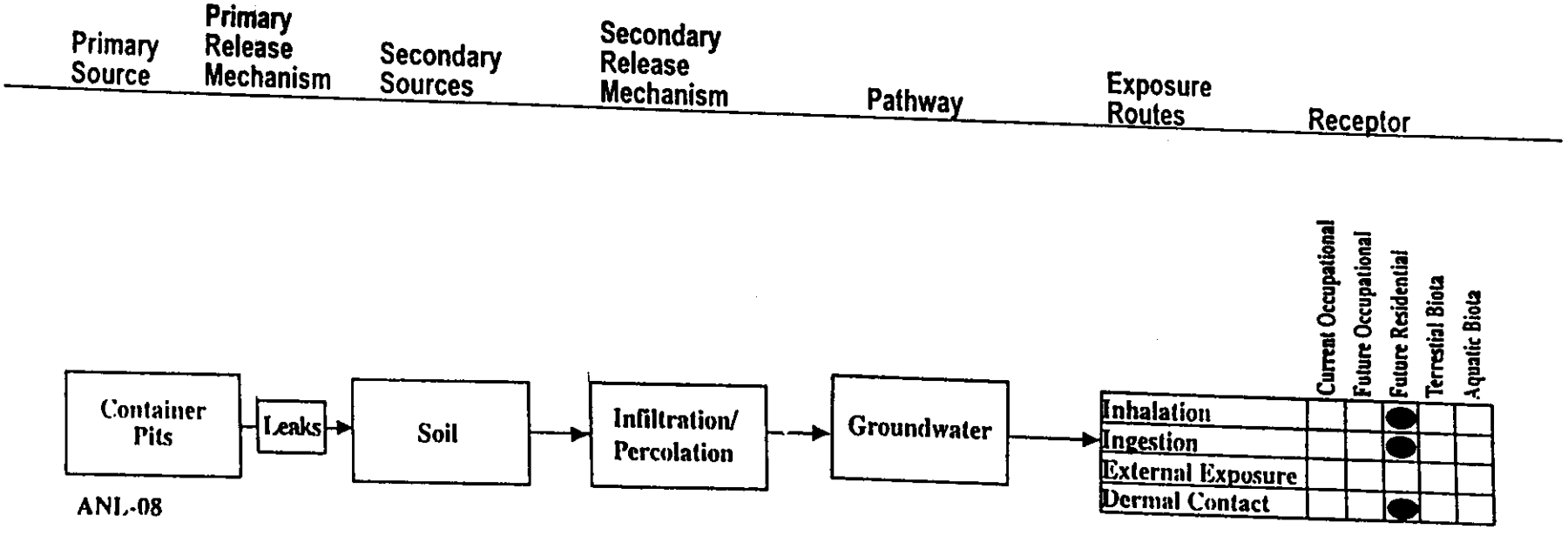

Figure 7-1 Conceptual Site Model of Leach Pit Vadose Zone Soils (below ANL-08)

Physical properties that will be analyzed for in the basalt include: Cation Exchange Capacity, Grain Size, % Organic Carbon (TOC), Acid/Base Potential, Permeability, Porosity, % Moisture, Bulk Density and Natural and Dry Specific Conductivity. These physical properties will enable ANL-W to use more site specific data in the modeling program that will be used (i.e., GWSCREEN).

7.6.2 Identifying Data Quality Levels Needed

EPA has established five analytical levels (I, II, III, IV and V) which correspond to data uses. For this SAP ANL-W will only use levels III and IV. ANL-W will request Volatile organics, Semivolative organics, Pesticide organics, Metals and Dioxin/Furans data in the CLP format (level IV) for all units being investigated. Radiological work will be performed using level III procedures. A brief description of each of the analytical levels is shown below:

III Analysis performed in a laboratory following well documented and standardized procedures. Procedures may be approved by the EPA or the American Society for Testing and Materials (ASTM), but other well-documented procedures with controlled analytical methods such as those used by the U.S. Geological Survey or the INEL Radiation Measurements Laboratory are acceptable. Analytical precision and accuracy must be either documented in procedures or determined from standards, duplicates, and blanks. The extensive documentation procedures required by the Contract Laboratory Program (CLP) level IV analysis are not utilized.

IV Analysis performed at a laboratory following EPA approved procedures include, but are not limited to, the EPA CLP Routine Analytical Services (RAS) protocols and SW-846. Any analytical data must be accompanied by a complete CLP type data package containing all raw laboratory data. The quality control requirements of the methods and the documentation of quality control results must be as thorough as those used in the CLP protocols.

7.7 General Sampling Approach

- A qualitative description of soil samples (texture, color, apparent moisture content, smell, and grain size) will be recorded in the sample log book by the subcontracted field team leader.

- At sample points where interbeds are encountered, samples will be collected using a hollow stem drill rig with split spoon in accordance with ER-SOP-11.12 (Soil Sampling). The anticipated depths of the interbeds are outlined in Table 7-5. The purpose of the subsurface sampling will be to determine the possible migration of the contaminants and to gather information to be used in the residential intrusion scenario. The sample will be placed in a new clean sample jar and sealed. The sample will be labeled using a unique sample identification number that designates the date, time, sampler, site and grid location. The chain of custody seal will be attached and the sample jar will be wrapped in bubble wrap and placed in a sample cooler.

- All sample coolers sent off the ANL-W site for analysis will undergo a Beta Gamma screen by the ANL-W HP Technician and be green tagged prior to shipment.

- All samples being analyzed for Volatile organics will be analyzed for the Contract Laboratory Program Target Compound Lists found in Attachment A, Table 1 of the QAPjP.

- All samples being analyzed for Semivolatile organics will be analyzed for the Contract Laboratory Program Target Compound Lists found in Attachment A, Table 2 of the QAPjP.

- All samples being analyzed for Pesticide organics will be analyzed for the Contract Laboratory Program Target Compound Lists found in Attachment A, Table 3 of the QAPjP.

- All samples being analyzed for metals will be analyzed for the Contract Laboratory Program Target Analyte List of Metals found in Attachment A, Table 4 of the QAPjP. The methods for the metals will be the default Inductively Coupled Plasma (ICP) method 200.7 except for the following shown in Table 7-3. The analysis method changes are being used to get better detection limits on the metals that are at or near the INEL background values.

Table 7-3 Deviations from CLP methods 200.7 for Metals.

Metal	Method Number	Analysis Method	Approximate Detection Limit (mg/kg)
Arsenic	206.2	AA-Furnace	0.2
Beryllium	210.2	AA-Furnace	0.04
Cyanide	ILMO3	CA	0.5
Lead	239.2	AA-Furnace	0.2
Mercury	245.5	Cold Vapor	0.2
Selenium	270.2	AA-Furnace	0.4
Thallium	279.2	AA-Furnace	0.2

- All samples being analyzed for radionuclides will be analyzed for only those radionuclides which are still retained as COCs. The Environmental Restoration Target Isotopic List has been shorted to include only the COCs which are retained for the vadose zone characterization and are shown in Table 7-4

- All samples sent in for Dioxin/Furans analysis will be analyzed using the Contract Laboratory Program method for the Target Compound Lists.

Table 7-4. ER Radionuclide Target Isotope List			
Isotope	Emission	Detection Limits	
		Soil (pCi/g)	Water (pCi/L)
Co-60	γ	*	*
Sr-90	β	0.5	1
I-129	γ	*	*
Cs-134	γ	*	*
Cs-137	γ	1	10
Np-237	α	*	*
U-234	α	*	*
U-235	γ	0.5	0.05
U-238	α	0.5	0.05
Pu-238	α	0.05	0.2
Pu-239/240	α	0.05	0.2
Am-241	α/γ	0.05	0.2
gross α	α	10	4
gross β	β	10	4

* Based on cesium-137, all other gamma isotopes shall have a detection limit commensurate with its photon yield and energy as related to the cesium-137 detection limit.

7.7.1 Quality Assurance/Quality Control Samples

The type and number of QA/QC samples that are needed for the vadose zone investigation are shown in Table 7-5 under sample type as QC samples. The QC Equipment Blank (water) samples will be collected in accordance with the schedule; and analyzed for CLP TAL Volatile organics, Semivolatile organics, Pesticides, Metals, and Dioxins this will allow for detection of possible cross contamination of sampling equipment and or cutting fluids. The QC duplicate samples will be used to determine sample heterogeneity and collected by spiting the homogenized sample. The QC split sample will be taken by homogenizing a sample into two portions and submitting the samples to separate laboratories.

7.7.2 Sampling Strategy for Leach Pit Vadose Zone Sampling

The sampling strategy for the vadose zone sampling is as follows. A continuous core will be collected in 10 foot sections to a depth of 200 feet. The core sample will be collected using the Wireline and Lined Double-Wall Core Barrel Method as specified in 2.9.5 section D of the

Soil Sampling Standard Operating Procedure (LITCO, SOP 11.12, 3/31/94). The Wireline and Lined Double-Wall Core Barrel Method is the preferred method for collection of samples in the sediment interbeds on the INEL. Samples of the soil in the interbeds will be collected and sent in for analysis as shown in Table 7-5. The number of samples collected will depend on the number of interbeds below the Leach Pit. The samples will be expedited for analysis and if detections of COCs in the interbeds is greater than those in the INEL 95% tolerance limits with 95% confidence limits the corehole will be drilled from the 200 feet BGS to the water table (estimated at 640 feet below grade) with samples collected of the interbeds and analyzed. Upon completion of the coring, the corehole will be backfilled with bentonite pellets and concrete grout.

The core samples will be separated and placed into new sample containers. If the interbed sample is not large enough for the number of analyses required, the volatile organic sample will be eliminated, followed by the semivolatile organic, then metals. A qualified geologist will examine the core for any wetted areas, and collect samples to determine physical characteristics of the basalt. The physical characteristics will be used to aid ANL-W in determining the actual vadose zone condition below the Leach Pit. ANL-W has estimated that 20 samples of the basalt will be submitted for the physical parameters listed in Table 7-6. The estimated depth to the interbeds was determined by examining the well log for ANL-MON-11 as shown in Appendix I of the Work Plan and the difference in elevation between the well and the Leach Pit. Approximately 10 feet has been added to each interbed depth from ANL-MON-11 to account for this change in elevation. ANL-W has specified a number of trip blank quality control samples in this SAP. This was done to ensure that the holding times are met for samples due to the long waiting periods between core samples. ANL-W estimates that approximately 100 feet can be cored and sampled for each sample cooler. A summary of the interbed, sample i.d., media, sample type, collection type, analysis to be performed and estimated depth is shown in Table 7-5.

Table 7-5 Leach Pit Vadose Zone Sample Location, Media, Type, Analysis, and Depth

Interbed #	Sample ID	Media	Sample Type	Collection Type	Analysis	Estimated Depth (ft)
N/A	ANL-82-96	Water	QC-Equipment Blank	N/A	All None Rad	N/A
#1	ANL-83-96	Interbed	Regular	Grab	All	20
#1	ANL-84-96	Interbed	QC	Duplicate	All	20
#2	ANL-85-96	Interbed	Regular	Grab	All	36
#2	ANL-86-96	Interbed	QC	Duplicate	All	36
N/A	ANL-87-96	Water	QC-Trip Blank	N/A	Volatile organics	N/A
#3	ANL-88-96	Interbed	Regular	Grab	All	126
#3	ANL-89-96	Interbed	QC	Duplicate	All	126
N/A	ANL-90-96	Water	QC-Equipment Blank	N/A	All None Rad	N/A
#4	ANL-91-96	Interbed	Regular	Grab	All	170
N/A	ANL-92-96	Water	QC-Trip Blank	N/A	Volatile organics	N/A
#5	ANL-93-96	Interbed	Regular	Grab	All	270
#5	ANL-94-96	Interbed	QC	Replicate	All	270
N/A	ANL-95-96	Water	QC-Trip Blank	N/A	Volatile organics	N/A
#6	ANL-96-96	Interbed	Regular	Grab	All	405
N/A	ANL-97-96	Water	QC-Trip Blank	N/A	Volatile organics	N/A
#7	ANL-98-96	Interbed	Regular	Grab	All	550
#7	ANL-99-96	Interbed	QC	Duplicate	All	550
#8	ANL-100-96	Interbed	Regular	Grab	All	560
N/A	ANL-101-96	Water	QC-Trip Blank	N/A	Volatile organics	N/A
#9	ANL-102-96	Interbed	Regular	Grab	All	590
#10	ANL-103-96	Interbed	Regular	Grab	All	600
#10	ANL-104-96	Interbed	QC	Duplicate	All	600
#11	ANL-105-96	Interbed	Regular	Grab	All	615
N/A	ANL-106-96	Water	QC-Trip Blank	N/A	Volatile organics	N/A
#12	ANL-107-96	Interbed	Regular	Grab	All	618
N/A	ANL-108-96	Water	QC-Equipment Blank	N/A	All None Rad	N/A

Shaded area indicates samples that will be collected only if COCs have been detected in the t interbed prior to the 200 foot depth.
All refers to Target Analyte List for Volatiles, Semivolatiles, Pesticide, Metals, Radionuclides, and Dioxins as identified in Section 7.7 of this FSP.
All None Rad - refers to Target Analyte List for Volatiles, Semivolatiles, Pesticide, Metals, and Dioxins as identified in Section 7.7 of this FSP.

Table 7-6 Physical Parameters and Methods for Basalt Samples		
Est. Qty.	**Parameters**	**Method**
20	Cation Exchange Capacity	SW846 9081
20	Grain Size	ASTM D422
20	% Organic Carbon (TOC)	MSA Agronomy #9
20	Acid/Base Potential	MSA Agronomy #9
20	Permeability	ASTM D2434 or EPA 9100, According to soil texture.
20	Porosity	MSA Agronomy #9
20	% Moisture	ASTM D2216
20	Bulk Density, Natural and Dry	ASTM methods depend on soil texture
20	Specific Conductivity	MAS Agronomy #9

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8 QUALITY ASSURANCE PROJECT PLAN

All of the samples collected in the field season for the comprehensive RI/FS as specified in the Work Plan will collected and analyzed in accordance with the Quality Assurance Project Plan (QAPjP) for Argonne National Laboratory-West dated October 6, 1994. This QAPjP was submitted and reviewed as part of the WAG 9 Sampling and Analysis Plan for Operable Units 9-01, 9-03 and 9-04 in the fall of 1994. In an effort to save on paper, ANL-W will not resubmit this QAPjP because it is already in the Administrative Record. If the EPA and IDHW can not find their copies of this document ANL-W will resubmit it upon their request.

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9 REFERENCES

Argonne National Laboratory-West, (ANL-W), 1973, *Facility Waste Descriptions Argonne-West*, Draft, December 14.

ANL-W, 1986, *Initial Assessment Reports for Waste Area Group (WAG) 9*, September 9 - October 8.

ANL-W, 1987, *Summary Assessment Reports for ANL-15 and ANL-16*, October 21.

ANL-W, 1988, *Summary Assessment Reports for ANL-20, ANL-32, and ANL-33*, June 21.

ANL-W, 1989, *Summary Assessment Reports for ANL-17 and ANL-27*, Submitted to EPA March 16.

ANL-W, 1990, "Request for Proposal (RFP) No. 9029-W for EBR-II Leach Pit and Monitoring Well," Argonne National Laboratory-West, INEL.

ANL-W, 1990a, *Summary Assessment Reports for ANL-11, ANL-14, ANL-21, ANL-25, and ANL-26*, November 30.

ANL-W, 1990b, *Summary Assessment Report for ANL-12*, Submitted to EPA April.

ANL-W, 1993, *Track 2 Preliminary Scoping Package for ANL-53, Cooling Tower Riser Pits*, December 29.

ANL-W, 1994a, *Track 1 Decision Document Package, ANL-30, Sanitary Waste Lift Station (778)*, July.

ANL-W, 1994b, *Track 1 Decision Document Package, ANL-60, Knawa Butte Debris Pile*, July.

ANL-W, 1994c, *Track 1 Decision Document Package, ANL-62, Sodium Boiler Building Hotwell (766)*, July.

ANL-W, 1995a, *Track 1 Decision Document Package, ANL-04, ANL-W Sewage Lagoons*, April 13.

ANL-W, 1995b, *Track 1 Decision Document Package, ANL-29, Industrial Waste Lift Station (778-A)*, April 13.

ANL-W, 1995c, *Revised Track 2 Summary Report for Operable Unit 9-03: Open Burn Pits (1,2, and 3), Industrial/Sanitary Waste Lift Station, and the Fuel Oil Spill by Building 755 at the Idaho National Engineering Laboratory*, Vol. 2, November.

ANL-W, 1995d, *Revised Preliminary Scoping Package for ANL-01, Industrial Waste Pond and Three Ditches for Operable Unit 9-04 RI/FS Sites,* April 27.

ANL-W, 1995e, *Revised Preliminary Scoping Package for ANL-01A, Main Cooling Tower Blowdown Ditch for Operable Unit 9-04 RI/FS Sites,* April 27.

ANL-W, 1995f, *Revised Preliminary Scoping Package for ANL-09, Interceptor Canal for Operable Unit 9-04 RI/FS Sites,* April 27.

ANL-W, 1995g, *Revised Preliminary Scoping Package for ANL-35, Industrial Waste Lift Station Discharge Ditch for Operable Unit 9-04 RI/FS Sites,* April 27.

ANL-W, 1995h, *Final Scope of Work for the Waste Area Group 9 Comprehensive Remedial Investigation/Feasibility Study at the Idaho National Engineering Laboratory,* W7500-4248-ES-02, Revision 2, November.

Braun, D. R., 1992, *ANL-W 779 Pond Seepage Test,* EGG-FE-10499, Project File 015578, EG&G Idaho, Inc., Idaho Falls, Idaho, November, 1992.

Chen Northern Inc., 1989a, *Background Soil and Water-Quality Sampling at Argonne National Laboratories-West*, Idaho National Engineering Laboratory, Boise, Idaho, August 28, 1989.

Chen Northern Inc., 1989b, *Soils and Surface Investigations at North Ditch and Industrial Waste Pond Ditch Argonne National Laboratories-West*, Idaho National Engineering Laboratory, Boise, Idaho, August 28, 1989.

Chen Northern Inc., 1991, *Hydrogeological Characterization of Main Cooling Tower Ditch Argonne National Laboratories-West*, Idaho National Engineering Laboratory, Boise, Idaho, April 17, 1991.

CH_2M Hill, Inc., 1978, *Industrial Wastewater Management Phase I Report for Argonne National Laboratories-West*, Idaho National Engineering Laboratory, .

DOE, 1994, *Track 2 Sites: Guidance for Assessing Low Probability Hazard Sites at INEL*, Draft, Revision 6, DOE/ID-10389, January 1994.

DOE-ID, 1991, State of Idaho, Department of Health and Welfare; U.S. Environmental Protection Agency; and Idaho National Engineering Laboratory (INEL); Action Plan for Implementation of the Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory", December 1991, pp. 8-15.

DOE, 1991a, *INEL Federal Facilities Agreement/Consent Order, Final,* U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho, 1991.

Doherty, D. J., 1979, *Drilling Data From Exploration Hole INEL-1*, NE 1/4, sec. 22, T.2N., R.32E., Bingham County, Idaho, U.S. Geological Survey Open File Report 79-1225.

EPA, 1982, *Prescribed Procedures for the Measurement of Radioactivity in Drinking Water*, EPA 600/4-80-032.

EPA, 1986, *Test Methods For Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition*, Final update IIB.

EPA, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA "Interim Final"*, EPA/540/G-89/004, October.

EPA, 1989a *Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual "Interim Final"*, EPA/540/1-89/002, January.

EPA, 1991, *Supplemental Guidance for Superfund Risk Assessment in Region 10,* August.

EPA, 1992a, *Framework for Ecological Risk Assessment*, EPA/630/R-92/001, PB93-102192, U.S. Environmental Protection Agency, ORD/Risk Assessment Forum, February, pp. 55

EPA, 1992b, *Guidance for Data Useability in Risk Assessment (Part A)*, PB92-963356, April.

EPA, 1992c, *Guidance for Data Useability in Risk Assessment Part B)*, PB92-963362, May.

EPA, 1992d, *Supplemental Guidance to RAGS: Calculating the Concentration Term*, Publication 9285.7-081, May.

EPA, 1995a, *Health Effects Assessment Summary Tables, FY-1995 Annual*, PB95-921199, May.

EPA, 1995b, *Health Effects Assessment Summary Tables, Fy-1995 Supplement*, PB95-921101, November.

EPA, 1996, *Integrated Risk Information System*, On-line Database.

Freeze, R. A., and J. A. Cherry, 1979, Groundwater, Prentice-Hall, 604 p.

Holzemer, M. J., 1986, *1985 Environmental Monitoring Report for Argonne National Laboratory-West*, Argonne National Laboratory-West, Idaho Falls, Idaho, August 1986.

Hukari, N., 1995, National Oceanic and Atmospheric Administration, personnel communication.

Hull, L. C., 1989, *Conceptual Model and Descriptions of the Environment for the TRA Warm Waste Pond (Waste Management Unit TRA-03)*, EGG-ER-8644, EG&G Idaho, Inc., Idaho Falls, Idaho, October 1989.

INEL, 1995, *Guidance Protocol for the Performance of Cumulative Risk Assessments at the INEL*, INEL-95/131, Rev. 0, May.

Jessmore, P.J. et al., 1996, *Remedial Investigation/Feasibility Study Report for Operable Unit 10-06: Radionuclide-contaminated Soils at the Idaho National Engineering Laboratory (Draft)*, INEL-94/0037, Revision 1, March.

Kuntz, M. L., 1978, *Stratigraphy of Lava Flows in Drill Holes at the Proposed Safety Research Experiment Facility (SAREF)*, Argonne National Laboratory-West, Idaho National Engineering Laboratory (INEL), Idaho, U.S. Geological Survey Open File Report 78-665.

Kuntz, M. L. and G. B. Dalrymple, 1980, *Geology, geochronology, and potential volcanic hazards in the Lava Ridge- Hells Half acre*, eastern Snake River Plain, Idaho, U.S. Geological Survey Open File Report 79-1657.

LATA (Los Alamos Technical Associates), Inc., 1990a, *Monitoring, Analysis, and Test Plan for EBR-II Leach Pit for Argonne National Laboratory-West*, W0001-0918-ES-02, Volume 1, August.

LATA, 1990b, *Monitoring, Analysis, and Test Plan for EBR-II Leach Pit for Argonne National Laboratory-West*, W0001-0918-ES-02, Volume II, August.

Levin, S. A., Harwell, M.A., Kelly, J. R. And Kimball, K. D., 1989, *Ecotoxicogy: problems and approaches*, Springer-Verlag, New York, New York, 547 pp.

Lockheed Idaho Technologies Company (LITCO), 1995a "Guidance Manual for Conduction Screening Level Ecological Risk Assessments at the INEL", INEL-95/0190, April, 1995.

Los Alamos Technical Associates, 1990, *Monitoring, Analysis, and Test Plan for EBR-II Leach Pit for Argonne National laboratory-West*, Volumes 1 and 2, August 1990.

Martin, C. J. and A. E. Powell, 1993, *Data Results from Aquifer Drawdown Tests on the ANL-W Production Wells*, Argonne National Laboratory-West, Idaho, ANL-93/36, 20 p.

Maughn, J. T., 1993, *Ecological Assessment of Hazardous Waste Sites*, Van Nostrand Reinhold, New York, New York, 32 pp.

Mitchell, R. G., D. Peterson, and D. L. Hoff, 1995, *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1994*, DOE/ID-12082(94).

Northern Engineering and Testing Inc., 1988, *Final Report Geohydrologic Investigation of Industrial Waste Pond at Argonne National Laboratories-West*, Idaho Falls, Idaho; Boise, Idaho, September 6, 1988.

Olson, G. L., *INEL Soil Map, Mapping Unit Descriptions, Soil Series Descriptions and Data*, June 15, 1993.

Opresko, D.M., Sample, B. E., and Suter, II, G. W., 1994, *Toxicological Benchmarks for Wildlife*: 1994 Revision, ES/ER/TM-86/R1. Oak Ridge National Laboratory, Oak Ridge, TN.

Orr, Brennon, 1996, United States Geologic Survey, personnel communication.

Pittman, J.R., Jensen, R.G., and Fischer, P.R., 1988, *Hydrologic Conditions at the Idaho National Engineering Laboratory, 1982-1985*, U.S. Geological Survey Water-Resources Investigations Report 89-4008 (DOE/ID-22078), 73 p.

Pohto, R., 1980, *Industrial Water Use at Argonne National Laboratory-West*, Argonne National Laboratory-West, Idaho Falls, Idaho, March 1980.

Roberston, J.B., 1974, *Digital Modeling of Radioactive and Chemical Waste Transport in the Snake River Plain Aquifer at the National Reactor Testing Station, Idaho*, U.S. Geological Survey National Reactor Testing Station Open-File Report, IDO-22054 (May).

Robertson, J.B., Schoen, R., and Barraclough, J.T., 1974, *The Influence of Liquid Waste Disposal on the Geochemistry of Water at the National Reactor Testing Station, Idaho: 1952-1970*, U.S. Geological Survey Open-File Report 73-238 (IDO-22053), 231 p.

Rood, 1994 *"GWSCREEN: A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination"*, EGG-GEO-10797, Rev 2, June 1994.

Rood, S. M., G. A. Harris, and G. J. White, 1995, *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclides Concentrations for the Idaho National Engineering Laboratory*, INEL-94-0250, Rev. 0, February 1995.

RUST Geotech Inc., 1994a, *Track 1 Decision Document Package, ANL-19, Imhoff Tank and Sludge Pit,* April.

RUST Geotech Inc., 1994b, *Track 1 Decision Document Package, ANL-28, EBR-II Sump,* July.

RUST Geotech Inc., 1994c, *Track 1 Decision Document Package, ANL-36, TREAT Photo Processing Discharge Ditch,* July.

RUST Geotech Inc., 1994d, *Track 1 Decision Document Package, ANL-61, EBR-88 Transformer Yard,* July.

RUST Geotech Inc., 1994e, *Track 1 Decision Document Package, ANL-63, Septic Tank 789-A,* July.

RUST Geotech Inc., 1994f, *Preliminary Scoping Track 2 Summary Report for Operable Unit 9-02; EBR-II Leach Pit,* DOE/ID-12584-162, April 11.

RUST Geotech Inc., 1994g, *Track 2 Preliminary Scoping Package for ANL-53, Cooling Tower Riser Pits, Operable Unit 9-03*, DOE/ID-12584, January.

VanHorn, R.L., N.L. Hampton, R.C. Morris, 1995, *Guidance Manual for Conducting Screening Level Ecological Risk Assessments at the INEL*, INEL-95/0190, April 1995.